

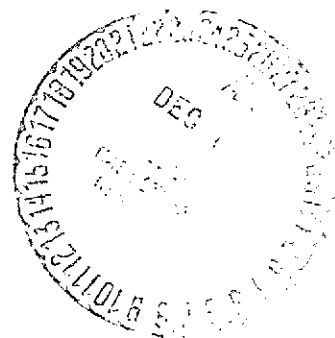


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**A SPECIAL BIBLIOGRAPHY
WITH INDEXES
Supplement 46**

JULY 1974



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AERONAUTICAL ENGINEERING

A Special Bibliography

Supplement 46

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in June 1974 in

- *Scientific and Technical Aerospace Reports (STAR)*
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JULY 1974
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INTRODUCTION

Under the terms of an interagency agreement with the Federal Aviation Administration this publication has been prepared by the National Aeronautics and Space Administration for the joint use of both agencies and the scientific and technical community concerned with the field of aeronautical engineering. The first issue of this bibliography was published in September 1970 and the first supplement in January 1971. Since that time, monthly supplements have been issued.

This supplement to *Aeronautical Engineering—A Special Bibliography* (NASA SP-7037) lists 374 reports, journal articles, and other documents originally announced in June 1974 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*.

The coverage includes documents on the engineering and theoretical aspects of design, construction, evaluation, testing, operation, and performance of aircraft (including aircraft engines) and associated components, equipment, and systems. It also includes research and development in aerodynamics, aeronautics, and ground support equipment for aeronautical vehicles.

Each entry in the bibliography consists of a standard bibliographic citation accompanied in most cases by an abstract. The listing of the entries is arranged in two major sections, *IAA Entries* and *STAR Entries*, in that order. The citations, and abstracts when available, are reproduced exactly as they appeared originally in *IAA* or *STAR*, including the original accession numbers from the respective announcement journals. This procedure, which saves time and money, accounts for the slight variation in citation appearances.

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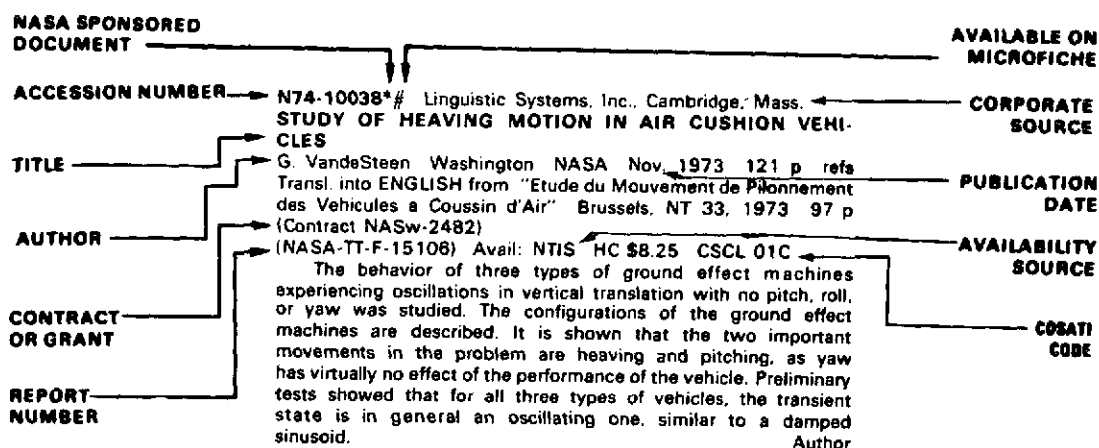
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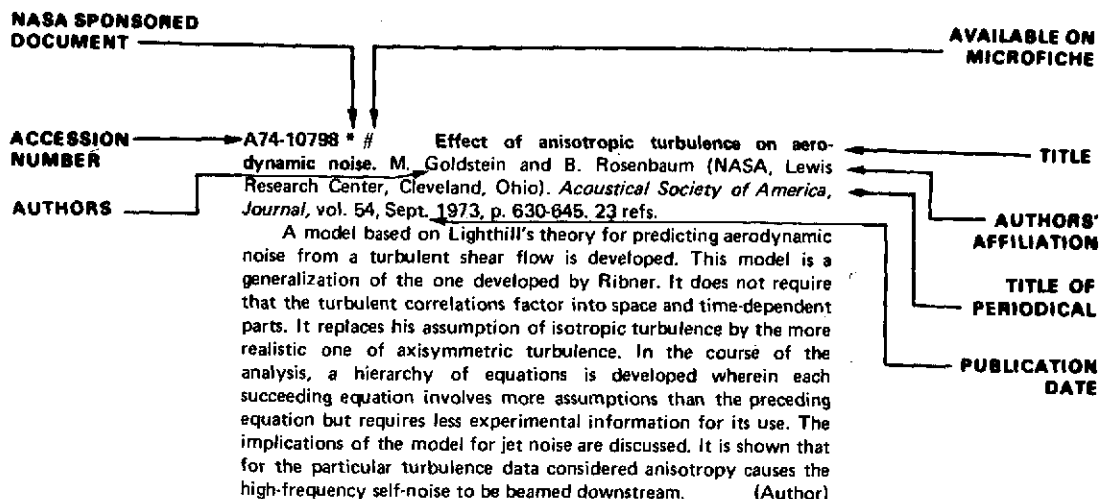
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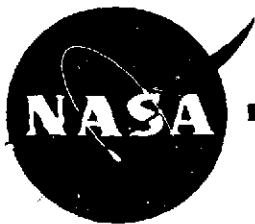
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TYPICAL CITATION AND ABSTRACT FROM IAA





AERONAUTICAL ENGINEERING

A Special Bibliography (Suppl. 46)

JULY 1974

IAA ENTRIES

A74-25670 # The effects of ionospheric scintillation on satellite communications. A. L. Johnson (USAF, Avionics Laboratory, Wright-Patterson AFB, Ohio). *Air University Review*, vol. 25, Nov.-Dec. 1973, p. 26-31.

Scintillation effects produced by moving ionospheric irregularities are discussed in terms of the fading and enhancement of signals at frequencies normally used for aircraft communications (HF, VHF, and UHF). Attention is given to experiments involving specially instrumented aircraft working in conjunction with ground stations to uncover problems unique to satellite communications with a mobile terminal. Curves show amplitude distributions of 250 MHz downlink signals from the TACSAT satellite as received by ground and airborne stations. T.M.

A74-25671 # Why military airplanes cost so much and what can be done about it. F. T. Stark (McDonnell Douglas Corp., St. Louis, Mo.). *Air University Review*, vol. 25, Nov.-Dec. 1973, p. 94-101.

The rise in the development and production costs of military aircraft is compared to the price history of commercial transport aircraft and other consumer products. Attention is given to reasons responsible for the notably higher costs of military aircraft in spite of current improved technology and manufacturing techniques. The examined causes of elevated costs include higher performance requirements, added equipment and accessories, lack of design expertise due to the infrequency of development programs, changes in requirements, and unnecessary bureaucratic efforts. Suggestions for minimizing the effects of these factors are proposed. T.M.

A74-25675 F-15 performance. II - Simplicity is stressed in F-15 operations, maintenance. C. Martin. *Aviation Week and Space Technology*, vol. 100, Apr. 1, 1974, p. 50-53.

Second of a series of reviews of the design and performance characteristics of the F-15 fighter, particularly devoted to aspects of maintenance ease, such as component accessibility and exchangeability, and to those of reliability and safety. Accomplished advances are illustrated by comparisons with the current front-line fighter, the F-4. M.V.E.

A74-25717 Modified centrifuge technique for hydrolytic stability of neopentyl polyol ester lubricants. J. A. Pace (U.S. Army, Medical Research Institute of Infectious Diseases, Fort Detrick, Md.). *Journal of Testing and Evaluation*, vol. 2, Mar. 1974, p. 71, 72. 6

refs. Navy-sponsored research.

The ASTM test for hydrolytic stability of hydraulic fluids was used to test five neopentyl polyol ester lubricants. It was found that some of the neopentyl polyol ester lubricants could not be readily separated and water washed by the technique specified in the ASTM test, and several modifications to that technique are proposed which significantly improved the results of subsequent testing. P.T.H.

A74-25723 Does research in the field of aeronautics have a future (Hat die Luftfahrtforschung noch eine Zukunft). G. Brüning and K. Gersten. *DGLR Mitteilungen*, vol. 7, Feb. 1974, p. 2-6. In German.

Since aviation technology has attained such a high degree of development, the question is raised concerning remaining possibilities for further growth. Clearly, much effort will be devoted to cost reduction and the refinement of present technology. However, many new fields of research are just beginning to be opened up. These include controlled configuration vehicles, the application of computers to engineering problems, the use of computers in navigation systems, noise reduction, atomic fuels, and composite materials. It is stressed that cooperation between European nations will be necessary for overcoming cost limitations in European research. P.T.H.

A74-25741 # R-NAV systems development for a STOL application. F. C. Black (Ministry of Transport, Ottawa, Canada). (Canadian Aeronautics and Space Institute, Flight Test Symposium, Ottawa, Canada, Mar. 7, 8, 1973.) *Canadian Aeronautics and Space Journal*, vol. 20, Feb. 1974, p. 51-57.

For the past two years the Canadian Ministry of Transport's STOL Project Office has been involved in the development of area-navigation systems and procedures for high density area STOL operations. An attempt is made to describe the work that has been carried out to date as well as provide some insight into the future impact of R-NAV for CTOL as well as STOL applications. The mission objectives, definitions, and constraints are discussed, touching on such areas as proposed landing sites, terminal airspace, and traffic volumes. The present method used in navigating and controlling traffic in terminal airspace is examined to define limitations in terms of pilot/controller workload and existing system capacities. The concept of terminal area R-NAV usage is introduced with a discussion of improved terminal capacities with equivalent or decreased workloads. (Author)

A74-25747 Minimum induced drag of wings with given lift and root-bending moment. A. Klein (Motoren- und Turbinen-Union München GmbH, Munich, West Germany) and S. P. Viswanathan (Georgia Institute of Technology, Atlanta, Ga.). *Zeitschrift für angewandte Mathematik und Physik*, vol. 24, Nov. 25, 1973, p. 886-892.

Assuming a direct proportionality between the weight of the spars and the local bending moment, Prandtl (1933) has shown that the induced drag of the wings is determined not only by the lift, but

also by the moment of inertia of the spanwise lift distributions. The investigation reported is concerned with an alternative to Prandtl's problem. A solution is derived for the case in which the lift and the root-bending moment produced by the spanwise lift distribution are specified.

G.R.

A74-25759 Identification of aircraft stability and control parameters using hierarchical state estimation. C. M. Fry and A. P. Sage (Southern Methodist University, Dallas, Tex.). *IEEE Transactions on Aerospace and Electronic Systems*, vol. AES-10, Mar. 1974, p. 255-273. 18 refs. NSF Grant No. GK-33348.

A74-25800 # The technical aspects of supersonic civil transport aircraft. G. Edwards (British Aircraft Corp., Ltd., London, England). *Royal Society (London), Philosophical Transactions, Series A*, vol. 275, no. 1254, Mar. 21, 1974, p. 529-565.

The paper discusses those technical aspects of a supersonic civil transport aircraft which peculiarly distinguish it from conventional subsonic civil aircraft. The physical, economic, and ecological environments in which the supersonic transport must operate are considered, and the main stepping stones to the development of the supersonic transport are traced. The basic differences between the supersonic transport and subsonic transports can be traced to two causes - the high-temperature environment and the disparity between subsonic and supersonic aerodynamics. The considerations which lead to the choice of speed, configuration and powerplant are considered, and some details of their impact on specific areas are discussed. Finally, Concorde is used to illustrate the development of a practical supersonic transport and the development, from both theory and experiment, of the practical parameters and features for such a vehicle.

(Author)

A74-25813 Thick ion-vapor-deposited aluminum coatings for irregularly shaped aircraft and spacecraft parts. K. E. Steube and L. E. McCrary (McDonnell Aircraft Co., St. Louis, Mo.). (*American Vacuum Society, National Symposium, 20th, New York, N.Y., Oct. 9-12, 1973*.) *Journal of Vacuum Science and Technology*, vol. 11, Jan.-Feb. 1974, p. 362-365. 12 refs.

Ion vapor deposition (IVD) differs from physical vapor deposition in that the substrate is held at a high negative potential with respect to the vapor source. The present work discusses the merits of this plating process. A highly adhesive coating can be deposited with good uniformity and can be made to vary in thickness. Since IVD plating is not confined to areas within line of sight, parts with complex shapes can be plated. Photographs of IVD-coated parts are shown, including fasteners, spacecraft coolant systems tubing, spacecraft teleprinter rotors, and missile launcher components. Problems of fixturing, overheating of the substrate, and substrate sputtering are discussed.

P.T.H.

A74-25969 Incremental transfer effectiveness of a ground-based general aviation trainer. H. K. Povenmire and S. N. Roscoe (Illinois, University, Urbana, Ill.). *Human Factors*, vol. 15, Dec. 1973, p. 534-542. 9 refs. Contract No. F44620-70-C-0105.

An experiment was conducted to establish the incremental transfer effectiveness of a representative ground-based general aviation trainer to serve as a basis for the evaluation of its incremental cost effectiveness. Four groups of student pilots were given, respectively, 0, 3, 7, and 11 hours of instruction in the Link GAT-1 concurrently with flight instruction in the Piper Cherokee airplane. Average flight times for the four groups to reach the private pilot criterion reflected the postulated negatively decelerated nature of the incremental transfer effectiveness function.

(Author)

A74-25971 * A study of vertical motion requirements for landing simulation. R. S. Bray (NASA, Ames Research Center, Moffett Field, Calif.). *Human Factors*, vol. 15, Dec. 1973, p.

561-568.

Tests were conducted to determine the significance of vertical acceleration cues in the simulation of the visual approach and landing maneuver. Landing performance measures were obtained for four subject pilots operating a visual landing simulation mechanized in the Ames Height Control Test Apparatus, a device that provides up to plus or minus 40 ft of vertical motion. Test results indicate that vertical motion cues are utilized in the landing task, and that they are particularly important in the simulation of aircraft with marginal longitudinal-handling qualities. To assure vertical motion cues of the desired fidelity in the landing task, it appears, that a simulator must have excursion capabilities of at least 20 ft in either direction.

(Author)

A74-25973 Advanced instructional provisions and automated performance measurement. P. A. Knoop (USAF, Human Resources Laboratory, Wright-Patterson AFB, Ohio). *Human Factors*, vol. 15, Dec. 1973, p. 583-597. 7 refs.

An advanced simulation research system is being developed to support experiments oriented toward quantifying the effect on transfer of training of alternative training and simulation techniques. Included in the system is sophisticated training research software which automates most of the functions traditionally performed by flight simulator instructors or operators. Also under development are techniques for automatically assessing pilot proficiency in the simulator and in the operational aircraft. Recent feasibility studies in performance measurement resulted in identification of necessary flight variables for assessing proficiency on two undergraduate pilot training maneuvers, and established alternative approaches to developing measurement techniques on a broader scale.

(Author)

A74-25979 # Influence of measurement errors on the regression relationships of engine characteristics (Vliianie oshibok izmerenii na regressionnye zavisimosti kharakteristik dvigatelai). Iu. V. Kozhevnikov, M. Kh. Bikchantaev, and V. D. Shershukov. *Aviatsionnaya Tekhnika*, vol. 16, no. 4, 1973, p. 17-23. In Russian.

Kozhevnikov et al. (1971) previously described a method for deriving the regression of a reduced aircraft engine performance characteristic on the reduced rpm with allowance for errors in measuring both the engine performance and engine rpm under different operating conditions. The present work investigates the influence of errors in engine parameter measurements on the regression line of the reduced engine performance characteristic as a whole. Results of the analysis serve as the basis for specifying required levels of accuracy in engine parameter measurements. T.M.

A74-25984 # Determination of the shear stresses in spar walls in the design of a wing on the basis of a plate analogy (Opredelenie kasatel'nykh napriazhenii v stenkakh lonzheronov pri raschete kryla na osnove plastinnoi analogii). M. S. Safariev and V. T. Bezmel'nitsin. *Aviatsionnaya Tekhnika*, vol. 16, no. 4, 1973, p. 49-55. 10 refs. In Russian.

A74-25995 # Integral methods for the investigation of temperature fields in complex-configuration structure components of aircraft and their engines (Integral'nye metody issledovaniia temperaturnykh polei v elementakh konstruktsii letatel'nykh apparatov i ikh dvigatelei, imeiushchikh slozhnuiu konfiguratsiiu). L. I. Kudriashev and N. L. Men'shikh. *Aviatsionnaya Tekhnika*, vol. 16, no. 4, 1973, p. 120-125. In Russian.

A74-25998 # Designing aerodynamic ducts according to given conditions (Proektirovanie aerodinamicheskikh kanalov po napered zadannym usloviyam). V. A. Osipov and V. A. Andreev. *Aviatsionnaya Tekhnika*, vol. 16, no. 4, 1973, p. 135-138. In Russian.

Construction of an algorithm for obtaining a continuous frame of an aerodynamic duct surface corresponding to basic predetermined conditions. A method of obtaining the transverse frame of a duct surface is proposed which is based partly on the plotting of a graph which relates the diagram area to a certain coefficient which ranges in value from 0 to 1 and partly on the application of an affine compression along the y- and z-axes to the diagram contour to obtain the engineering contours of the duct cross sections. A.B.K.

A74-26025 # A method for the dynamic study of helicopter fuselages in the design phase (Metodo per lo studio dinamico della fusoliera degli elicotteri in fase di progetto). M. Borri (Milano, Politecnico, Milan, Italy). *Ingegneria*, Jan. 1974, p. 1-10. 12 refs. In Italian.

Description of a somewhat simplified method for calculating forced and free vibrations of a helicopter fuselage in the presence of very small dampings. The method involves the use of transfer matrices. The fuselage is schematized as a beam with its axis contained in the plane of symmetry of the helicopter. This schematization is obviously valid only in the first approximation, since for a helicopter fuselage the transverse dimensions are not small in comparison with the longitudinal dimensions. On the other hand, an analysis of the problem using this scheme requires only knowledge of the elastic and mass characteristics section by section, which can be evaluated with a discrete approximation even in the initial phases of design. A.B.K.

A74-26047 The effect of velocity-dependent pitching moments on longitudinal stability (Der Einfluss geschwindigkeitsabhängiger Nickmomente auf die Längsstabilität). G. Sachs (Darmstadt, Technische Hochschule, Darmstadt, West Germany). *Zeitschrift für Flugwissenschaften*, vol. 22, Mar. 1974, p. 74-83. 16 refs. In German.

The effects of speed-dependent pitching moments, $C(mV)$, on longitudinal stability are investigated. The speed ranges are subdivided as follows: hovering flight (VTOL aircraft), low-speed flight (including the aerodynamically borne STOL flight) and high-speed flight (high subsonic speed and supersonic speed). For the hovering flight range, the basic behavior of pitch rate and pitch attitude systems is considered. In regard to the low-speed range, the influence of $C(mV)$ on the eigenvalues is investigated, and it is shown how the effect of $C(mV)$ on phugoid damping changes with angle-of-attack stability. For the high-speed range, the effects of the density gradient on the influence of $C(mV)$ on longitudinal stability are shown.

A74-26326 # Influence of the intrinsic motion of the conveyance on the frequency selection system (Vliianie sobstvennogo dvizheniya nositel' na ustroystvo chastotnoi selektsii). Iu. A. Lavrent'ev. *Radiotekhnika*, vol. 28, Dec. 1973, p. 5-9. In Russian.

The yawing, rolling, pitching, and vibration of a radar-equipped aircraft lead to amplitude and frequency fluctuations of echo signals, thereby affecting the operation of frequency selection systems used for automatic velocity tracking of high-speed targets. The disturbed motion of the aircraft equipped with such a radar is considered to be caused by random atmospheric turbulence for purposes of the present study. Errors caused by such motion of the carrier aircraft are analyzed, and it is shown that they can be corrected by introducing information about the disturbances at the input of the frequency selection system. T.M.

A74-26345 * A solid-state converter for measurement of aircraft noise and sonic boom. A. J. Zuckerman (Youngstown State University, Youngstown, Ohio) and W. W. Shope (Ford Motor Co., Dearborn, Mich.). *IEEE Transactions on Instrumentation and Measurement*, vol. IM-23, Mar. 1974, p. 23-27. 8 refs. Grant No. NGR-36-028-004.

A solid-state converter, used in a system of instrumentation for measuring aircraft noise and sonic boom, features a dual-gate FET mixer and an output stage designed for compatibility with a zero

drive amplifier. With a half-inch condenser microphone the converter itself has an operating frequency range from dc-28 kHz (-3 dB), a dynamic range of 72 dB, and a noise floor of 50 dB in the band from 22.4 Hz to 22.4 kHz; the system requires no impedance matching networks and is insensitive to cable length up to at least 3000 ft.

(Author)

A74-26398 GE continues CF6 family growth. M. L. Yaffee. *Aviation Week and Space Technology*, vol. 100, Apr. 8, 1974, p. 41-44.

Review of the General Electric family plan for its CF6-6 and CF6-50 series of high-bypass-ratio turbofan engine development, as it now stands. The CF6-50J is the latest engine to go into development, but it is not expected to be the end of the line. It will have the highest maximum cruise thrust (11,700 lb.) and the lowest maximum cruise specific fuel consumption (0.640 lb/hr/lb) of any CF6-50 series engine and the lowest specific fuel consumption of all CF6 engines at 80% of maximum cruise thrust. M.V.E.

A74-26399 F-15 performance. III - New fighter to have ground attack role. C. Martin. *Aviation Week and Space Technology*, vol. 100, Apr. 8, 1974, p. 51-55.

Review of the main design and performance characteristics of the new McDonnell Douglas F-15 fighter. It is built to have a secondary role of air-to-ground attack. Its dual mission capability is said to have been incorporated with no compromise to its primary role. As an air combat machine, the new fighter incorporates the structural sturdiness, flight characteristics, avionics systems, and survivability features also required for the attack mission. Additionally, the F-15 has a considerable amount of undedicated volume, power reserve, and avionics capacity for growth in future roles such as photo reconnaissance and electronic intelligence gathering. M.V.E.

A74-26410 * RPRVs - The first and future flights. R. D. Reed (NASA, Flight Research Center, Edwards, Calif.). *Astronautics and Aeronautics*, vol. 12, Apr. 1974, p. 26-42. 5 refs.

The merits of the RPRV (remotely piloted research vehicle) concept are discussed, along with its historical background and development culmination in the 3/8-scale F-15. The use of RPRVs is shown to be especially attractive when testing must be done at low cost, or in quick response to demand, or when hazardous testing must assure the safety of proceeding to manned vehicles. M.V.E.

A74-26411 # Practical aspects of electrostatic stabilization. R. Markson (New York, State University, Albany, N.Y.). *Astronautics and Aeronautics*, vol. 12, Apr. 1974, p. 44-49. 14 refs.

An inexpensive, light-weight, electrostatic autopilot proposed for aircraft by Hill (1972) and based on information obtained from the earth's electric field is shown to involve serious hazards. For its ability to keep an aircraft straight and level this autopilot requires that the earth's electric field be at all times vertical. However, the total electric field vector is shown to be many times nonvertical, which could lead the autopilot to fly the aircraft tilted or steer it into the ground. M.V.E.

A74-26416 MRCA prepares for flight test. *Flight International*, vol. 105, Mar. 28, 1974, p. 395-399.

The multirole combat aircraft (MRCA) flight test program is the most comprehensive yet undertaken for any European military aircraft. Nine prototype and six preproduction MRCA's will take part in a closely integrated test schedule. Only in the later stages will this diverge to investigate the special requirements and equipment, particularly weapons, of Britain, West Germany, and Italy. The MRCA flight trials will be supported by a number of 'hack' aircraft equipped to investigate particular aspects in isolation from the main program. F.R.L.

A74-26417 MRCA nav-attack system. *Flight International*, vol. 105, Mar. 28, 1974, p. 400-402.

The system's most demanding mission is high-speed, all-weather penetration at extreme low level, culminating in a single-pass delivery on a point target. This mission relies on a forward-looking radar, inertial and Doppler navigation, digital computation of all main navigation and weapon-delivery functions, special displays for head-up track following and aiming and for making use of the computer, an autopilot providing full assurance for automatic flight in close proximity to the ground, and a maneuver-demand stability system giving the aircraft acceptable responses under any of its extremely variable flight conditions. The various systems and subsystems are described. F.R.L.

A74-26440 # Oscillations in an adaptive aircraft control system. L. S. Wisler and E. R. Rang (Honeywell, Inc., Minneapolis, Minn.). *ASME, Transactions, Series G - Journal of Dynamic Systems, Measurement, and Control*, vol. 96, Mar. 1974, p. 100, 101. Navy-supported research.

The origin of the limit cycles is investigated. It is found that the integration of the gain-changer plus the second order dynamics of the servo already are sufficient to produce limit cycles under large input commands. These conclusions are true also for the complete adaptive system outlined by Rang (1971). The limit cycle problem may be eliminated by a redesign of the system. Analog simulation shows that the resulting controller performs as expected. G.R.

A74-26477 * Dynamic stability testing of aircraft - Needs versus capabilities. K. J. Orlik-Rückemann (National Aeronautical Establishment, Ottawa, Canada). In: ICIAF '73; International Congress on Instrumentation in Aerospace Simulation Facilities, 5th, Pasadena, Calif., September 10-12, 1973, Record.

New York, Institute of Electrical and Electronics Engineers, Inc., 1973, p. 8-23. 17 refs. Contract No. NAS2-7279.

Highlights of a recent survey of the future needs for dynamic stability information for such aerospace vehicles as the Space Shuttle and advanced high-performance military aircraft, indicating the importance of obtaining this information for high-angle-of-attack high-Reynolds-number conditions. A review of the wind-tunnel capabilities in North America for measuring dynamic stability derivatives reveals an almost total lack of such capabilities for Mach numbers above 0.1 at angles of attack higher than 25 deg. In addition, capabilities to obtain certain new cross-coupling derivatives and information on effects of the coning motion are almost completely lacking. Recommendations are made regarding equipment that should be constructed to remedy this situation. (Author)

A74-26564 Royal Air Force experience of the Harrier /Second Sir Sydney Camm Lecture/. R. Wade (RAF, London, England). *Aeronautical Journal*, vol. 78, Jan. 1974, p. 1-6.

The Harrier is a rugged fighter ground attack aircraft with a unique vertical takeoff and landing capability. The aircraft is fitted with a Ferranti inertial navigation attack system which accurately portrays the aircraft position on a moving map display. The Harrier can carry up to 5000 lb of weapons. The reconnaissance capability of the aircraft is considered together with operational questions, organizational aspects, the probabilities of detecting a Harrier site, logistic support, and pilot training. G.R.

A74-26565 The concept of the WG-13. R. G. Austin (Westland Helicopters, Ltd., Yeovil, Somerset, England). *Aeronautical Journal*, vol. 78, Jan. 1974, p. 7-15.

The WG-3, which was eventually to become the WG-13, was a Westland conception for a small twin-engined helicopter which operated by the Army, could function as a light tactical support. The aircraft was designed to carry ten armed men in addition to the flight crew of two. Questions of aircraft maintenance and reliability are discussed together with the flex hinge rotor system, the improved rotor blade used, attempts to provide a device for measuring the

thrust of the rotor, and the merits of the aircraft loading facilities. The developments leading to the design of the WG-13 are reviewed. G.R.

A74-26566 The design of the WG-13. V. A. B. Rogers (Westland Helicopters, Ltd., Yeovil, Somerset, England). *Aeronautical Journal*, vol. 78, Jan. 1974, p. 15-23.

The concept of the WG-13, the Lynx stems from a series of project studies for a small tactical twin-engined helicopter. The Lynx exists in two basic variants, an army utility variant with a multipurpose role for the British army and a naval variant for use with small ships as an antisubmarine surface search and strike helicopter for the British and French navies. The specification characteristics for the operational variants of the Lynx are discussed together with the automatic flight control system and the new design concepts used. G.R.

A74-26567 The development of the WG-13. A. H. Smith (Westland Helicopters, Ltd., Yeovil, Somerset, England). *Aeronautical Journal*, vol. 78, Jan. 1974, p. 23-31.

The conception of the initial program for the aircraft is considered together with the management and development of this program. A completely rationalized overall program was completed by December of 1967. Two major changes to the program took place during the year 1969. The early months of 1971 saw the final preparation of the first basic aircraft for flight. Some aspects of development testing are discussed together with questions of flight testing and manufacture. G.R.

A74-26561 # Advanced Metallic Air Vehicle Structure Program. F. D. Boensch (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio) and C. E. Hart (General Dynamics Corp., Convair Aerospace Div., Fort Worth, Tex.). *AIAA, ASME, and SAE, Structures, Structural Dynamics and Materials Conference, 15th, Las Vegas, Nev., Apr. 17-19, 1974, AIAA Paper 74-336*. 11 p. Members, \$1.50; nonmembers, \$2.00.

The Advanced Metallic Air Vehicle Structure Program offers an opportunity to demonstrate potential increases in the reliability, integrity and efficiency of future Air Force Weapon Systems by the integration of new and emerging structures, material and manufacturing technologies during the design and development of a wing carry through structure. Program objectives and accomplishments are described briefly. Management methods and concepts found to be of value to the program manager are highlighted. Each phase of the program including preliminary design, detail design, fabrication, and test is described in some detail. Emphasis is placed on the use of trade studies during the design phase and the extensive development test program necessary to provide information for the detail design and manufacturing phases. (Author)

A74-26562 # Air Superiority Fighter wing structure design for improved cost, weight and integrity. F. A. Figge and L. Bernhardt (Northrop Corp., Hawthorne, Calif.). *AIAA, ASME, and SAE, Structures, Structural Dynamics and Materials Conference, 15th, Las Vegas, Nev., Apr. 17-19, 1974, AIAA Paper 74-337*. 8 p. Members, \$1.50; nonmembers, \$2.00. Contract No. F33615-72-C-1891. AF Project 486U.

This program was one of several intended to investigate new structural designs, which would be lighter, lower in cost, and have improved reliability when compared to a given baseline. The structure investigated in this program was that of a fighter wing, and the baseline chosen was the wing and carrythrough structure of the Northrop F-5E Air Superiority Fighter. The approach taken was to combine innovative designs, new materials, and manufacturing methods. An integral part was a comprehensive materials test program. A variety of configurations studied included features and combinations, such as: full depth honeycomb, integrally stiffened, thick-skin, and sandwich panel covers; various arrangements and constructions of spars; mechanically attached, welded, and adhesive

bonded assemblies; and aluminum and titanium alloys. Weight and cost comparisons were obtained. (Author)

A74-26653 # Air Superiority Fighter wing design for cost and weight reduction. R. W. McNally (General Dynamics Corp., Convair Aerospace Div., Fort Worth, Tex.). *AIAA, ASME, and SAE, Structures, Structural Dynamics and Materials Conference, 15th, Las Vegas, Nev., Apr. 17-19, 1974, AIAA Paper 74-338*. 11 p. 9 refs. Members, \$1.50; nonmembers, \$2.00. USAF-sponsored research.

Cost, weight, and structural integrity improvements were achieved in the preliminary design of several alternate wing box structures by exploiting advanced technology through a unique design method. Innovation, integration, advanced analysis methods, evaluation, concept ranking and selection were applied during successive, iterative steps. The initial step generated 119 element concepts, which were selectively integrated into 56 wing box cross-section concepts. The most promising cross-section concepts were reiterated with refinements and defined as 31 analytical assembly concepts for in depth analysis and evaluation. From these, the nine highest ranking concepts were redefined as complete wing box assemblies for evaluation and selection of a prime design and two alternates. The designs that emerged with lowest weight and the most significant structural integrity improvements were those that embodied adhesive or braze laminated lower panels without fastener penetrations, plus improved stabilization systems configured into compression and shear panels. (Author)

A74-26654 # Advanced structural concepts for transport aircraft wings. W. A. Pitman and C. R. Bigham (Lockheed-Georgia Co., Marietta, Ga.). *AIAA, ASME, and SAE, Structures, Structural Dynamics and Materials Conference, 15th, Las Vegas, Nev., Apr. 17-19, 1974, AIAA Paper 74-339*. 7 p. Members, \$1.50; nonmembers, \$2.00.

Preliminary design and analysis evaluations were made of numerous structural concepts seeking better solutions for problems common to transport aircraft wings. These problems are indicated by the objectives established for this program, which was conducted with the C-141 StarLifter inner wing box structure as the baseline. The objectives were to: (1) double the fatigue life, (2) significantly reduce acquisition cost, and (3) reduce weight. The objectives were pursued by means of iterative analyses of the candidate concepts, in which the benefits of advanced materials, novel design features, and advanced fabrication and assembly processes were evaluated. Three concepts were developed that meet the objectives and satisfy all design criteria. The three designs are projected to be, in varying degrees, considerably less costly to build and lighter in weight than the baseline. (Author)

A74-26655 # Application of advanced structures and materials to transport aircraft fuselages. J. E. McCarty (Boeing Commercial Airplane Co., Seattle, Wash.). *AIAA, ASME, and SAE, Structures, Structural Dynamics and Materials Conference, 15th, Las Vegas, Nev., Apr. 17-19, 1974, AIAA Paper 74-340*. 14 p. 8 refs. Members, \$1.50; nonmembers, \$2.00. Contract No. F33615-72-C-1893.

The application of advanced structures and materials to military and commercial transport aircraft must provide the user with performance and/or economic benefits. The potential benefits that may be derived from the application of advanced structures and materials are reviewed along with the rationale for the selection of the fuselage as the prime candidate for advanced structural development. The principal design approach taken in this study was that of applying adhesive bonding as the primary means of joining. The design, material utilization, and manufacturing advantages obtainable by using adhesive bonding were completely explored as well as the design constraints imposed. Included are both skin-stringer and honeycomb sandwich fuselage-shell concepts. The designs were compared to a common fuselage baseline (Boeing 747) of conventional state-of-the-art riveted structure to establish both cost and weight savings. (Author)

A74-26658 # Drop testing naval aircraft and the VSD landing gear dynamic test facility. C. C. Daughette (LTV Aerospace Corp., Dallas, Tex.). *AIAA, ASME, and SAE, Structures, Structural Dynamics and Materials Conference, 15th, Las Vegas, Nev., Apr. 17-19, 1974, AIAA Paper 74-343*. 10 p. Members, \$1.50; nonmembers, \$2.00. Contract No. N00019-72-C-0220.

This paper describes a laboratory facility and techniques used to realistically simulate landings of full scale aircraft under precisely controlled conditions. Capabilities are included to evaluate effects of running over deck obstructions during carrier landings or other types of bumps that might be encountered in rough field operations of aircraft. The project provided the most accurate method known for dynamic simulation of aircraft landings and safe evaluation of the structural adequacy of airframes and landing gear systems for landing loads. Operational characteristics of the facility are predictable and repeatable. A deck obstruction or bump can be repeatedly passed under the landing gear wheel within one-half inch of any preselected point in the stroke of a landing gear strut at any sink speed or landing velocity to 120 knots. (Author)

A74-26659 # Design of optimum structures to impulse type loading. V. B. Venkayya and N. S. Khot (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). *AIAA, ASME, and SAE, Structures, Structural Dynamics and Materials Conference, 15th, Las Vegas, Nev., Apr. 17-19, 1974, AIAA Paper 74-345*. 10 p. 9 refs. Members, \$1.50; nonmembers, \$2.00.

The purpose of this paper is to present the results of an analytical study on optimization problems involving large structures subjected to impulse type loading. The impact due to aircraft landing, aerodynamic gust, and the effect of blast waves are a few examples of impulse type loadings on aerospace structures. The method of optimization presented in this paper is called designing in the dynamic mode. The dynamic mode may be a single natural mode of the structure or a combination of a set of natural modes depending on the spatial distribution and dynamic characteristics of the forcing function. The aperiodic forcing function is represented by a Fourier integral in determining the dynamic response. A procedure for determining the participating modes in the dynamic response is discussed. The illustrative examples are a wing structure and a circular arch. (Author)

A74-26660 # Structural aspects of current RPV's. D. J. Mourey (Teledyne Ryan Aeronautical Co., San Diego, Calif.). *AIAA, ASME, and SAE, Structures, Structural Dynamics and Materials Conference, 15th, Las Vegas, Nev., Apr. 17-19, 1974, AIAA Paper 74-346*. 12 p. 9 refs. Members, \$1.50; nonmembers, \$2.00.

A review of the current AQM-34, AQM-91, and BGM-34 series of remotely piloted vehicles (RPVs) discloses many structural design requirements similar to their manned counterparts. There are also numerous differences due to the RPV's unique requirements. The results of structural analyses and tests are shown in order to highlight the importance of the C-130 launch airplane upon RPV loads while captive. The important effects are from aerodynamic interference and from elastic structural response of the C-130. Simulation of the dynamics of parachute recovery illustrates the complex nature of this unique RPV structural requirement. Ground impact loads from tests are shown to be a function of recovery weight and the type of terrain upon which the impact occurs. (Author)

A74-26661 # Evaluation of damage tolerance in aircraft structures. H. I. McHenry and E. K. Hensley (General Dynamics Corp., Convair Aerospace Div., Fort Worth, Tex.). *AIAA, ASME, and SAE, Structures, Structural Dynamics and Materials Conference, 15th, Las Vegas, Nev., Apr. 17-19, 1974, AIAA Paper 74-347*. 11 p. 11 refs. Members, \$1.50; nonmembers, \$2.00. Contract No. F33615-73-C-3001.

The specific requirements and the evaluation procedures used to qualify the damage tolerance of two competing wing carrythrough

structure designs are reviewed. One design is principally beta-processed 6Al-4V titanium in a fail safe configuration, and the other is principally 10 Ni steel in a monolithic configuration. Fail safe analyses were conducted using finite element models with individual elements reduced in size or eliminated to simulate failure. Crack arrest was evaluated experimentally on panels with brazed stiffeners. Crack growth analyses were based on extensive test data and the Wheeler retardation model. (Author)

A74-26664 # Effects of fabrication defects on boron/epoxy composites. D. J. Thies, L. R. Sanders (McDonnell Aircraft Co., St. Louis, Mo.), and R. M. Neff (USAF, Materials Laboratory, Wright-Patterson AFB, Ohio). *AIAA, ASME, and SAE, Structures, Structural Dynamics and Materials Conference, 15th, Las Vegas, Nev., Apr. 17-19, 1974, AIAA Paper 74-352.* 10 p. Members, \$1.50; nonmembers, \$2.00.

The effects of common fabrication defects on the structural integrity of boron/epoxy composite structural elements were experimentally determined. Laminate and adhesive bondline defects were incorporated into test specimens during a fabrication sequence identical to that used for large aircraft components. Defects were verified as to location and extent through nondestructive testing. Specimens were statically tested at room temperature and 365 F and also fatigue tested at room temperature using constant amplitude loading with a stress ratio of either 0.1 or 10. This paper compares test results of specimens containing defects with baseline (defect-free) specimen test results. The effects of defect size and location are discussed as well as failure modes. Due to the general nature of the test specimens employed, the results are applicable to a wide range of boron/epoxy structures. (Author)

A74-26667 # Advanced composite lattice structure for improved structural integrity. A. Dobyns, J. Avery, R. Blaisdell (Boeing Aerospace Co., Seattle, Wash.), and I. E. Figge (U.S. Army, Air Mobility Research and Development Laboratory, Fort Eustis, Va.). *AIAA, ASME, and SAE, Structures, Structural Dynamics and Materials Conference, 15th, Las Vegas, Nev., Apr. 17-19, 1974, AIAA Paper 74-357.* 10 p. 8 refs. Members, \$1.50; nonmembers, \$2.00.

This paper discusses an alternate structural concept for utilizing fiber composites in aircraft applications requiring a high level of tolerance to in-flight damage. This concept is called 'composite lattice structure', and is configured from struts consisting of unidirectional layups. The structure is inherently damage tolerant because of its redundancy. A finite element structural analysis is described along with preliminary performance trade studies for aircraft applications. (Author)

A74-26668 * # A detailed investigation of flight buffeting response at subsonic and transonic speeds. D. B. Benepe, A. M. Cunningham, Jr., and W. D. Dunmyer (General Dynamics Corp., Convair Aerospace Div., Fort Worth, Tex.). *AIAA, ASME, and SAE, Structures, Structural Dynamics and Materials Conference, 15th, Las Vegas, Nev., Apr. 17-19, 1974, AIAA Paper 74-358.* 11 p. 11 refs. Members, \$1.50; nonmembers, \$2.00. Contract No. NAS2-7091.

The structural response to aerodynamic buffeting during moderate-to-high-g maneuvers was investigated. Dynamic response data measured during a flight loads program were analyzed to obtain power spectra and rms values of response for 19 sensors mounted on the test aircraft. In this paper, peaks in the power spectra of accelerations measured at the wing tips, center of gravity and pilot's seat, and wing vertical shear, bending moment and torsional moments are correlated with natural vibration modes. The amplitudes of response are compared to show effects of angle of attack, sensor type and location, Mach number, and altitude. (Author)

A74-26669 * # An oscillatory kernel function method for lifting surfaces in mixed transonic flow. A. M. Cunningham, Jr. (General Dynamics Corp., Convair Aerospace Div., Fort Worth, Tex.). *AIAA, ASME, and SAE, Structures, Structural Dynamics and Materials Conference, 15th, Las Vegas, Nev., Apr. 17-19, 1974, AIAA Paper 74-359.* 12 p. 12 refs. Members, \$1.50; nonmembers, \$2.00. Contracts No. NAS1-11565; No. NAS1-12399.

A study was conducted on the use of combined subsonic and supersonic linear theory to obtain economical and yet realistic solutions to unsteady transonic flow problems. With some modification, existing linear theory methods were combined into a single computer program. The method was applied to problems for which measured steady Mach number distributions and unsteady pressure distributions were available. By comparing theory and experiment, the transonic method showed a significant improvement over uniform flow methods. The results also indicated that more exact local Mach number effects and normal shock boundary conditions on the perturbation potential were needed. The validity of these improvements was demonstrated by application to steady flow. (Author)

A74-26670 # Unsteady transonic flow over oscillating circular-arc airfoils. K. Isogai (National Aerospace Laboratory, Tokyo, Japan). *AIAA, ASME, and SAE, Structures, Structural Dynamics and Materials Conference, 15th, Las Vegas, Nev., Apr. 17-19, 1974, AIAA Paper 74-360.* 12 p. 16 refs. Members, \$1.50; nonmembers, \$2.00.

An approximate method for predicting aerodynamic loadings on circular-arc airfoils oscillating in two-dimensional transonic flow at Mach number 1 or very near 1 is presented. Employing an idea analogous to the local linearization concept, a linear partial differential equation with variable coefficients for an unsteady small disturbance velocity potential is transformed into an approximate integral equation, which relates an unknown load distribution to a normalwash condition. A method for solving the integral equation is discussed and its working form is given together with appropriate forms of the kernel functions for numerical evaluation. Aerodynamic forces on circular-arc airfoils oscillating at Mach number 1 are calculated for several values of thickness to chord ratio, being compared with those predicted by the sonic theory. A considerable effect of the airfoil thickness on both the magnitudes and phase angles of the aerodynamic forces is disclosed. (Author)

A74-26674 # Effects of compressive overloads on fatigue crack growth. T. M. Hsu and L. W. Lassiter (Lockheed-Georgia Co., Marietta, Ga.). *AIAA, ASME, and SAE, Structures, Structural Dynamics and Materials Conference, 15th, Las Vegas, Nev., Apr. 17-19, 1974, AIAA Paper 74-365.* 8 p. 22 refs. Members, \$1.50; nonmembers, \$2.00.

A phenomenological examination of acceleration in the rate of fatigue crack growth on Ti-6AL-4V beta annealed and 7050-T73 plate materials produced by compressive overloads was conducted. The effects of various magnitudes of compressive overloads and the sequence of tension-compression overload cycle with applied load ratio equal to 1.0 on fatigue crack growth were investigated. The effects of truncation of compressive loads in a realistic flight-by-flight spectrum of the C-141 aircraft were also examined. Specimens used in the test had center cracks and the through-the-thickness cracks emanating from one side of a 1/4 inch hole. (Author)

A74-26675 # Methods for analyzing fatigue crack growth rate behavior associated with flight-by-flight loading. J. P. Gallagher and H. D. Stalnaker (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). *AIAA, ASME, and SAE, Structures, Structural Dynamics and Materials Conference, 15th, Las Vegas, Nev., Apr. 17-19, 1974, AIAA Paper 74-367.* 13 p. 29 refs. Members, \$1.50; nonmembers, \$2.00.

Several crack growth prediction approaches are examined for their ability to predict both the magnitude and trend of crack growth rate data generated under transport-wing flight simulation loading.

Three cycle by cycle accounting approaches, one with no load interaction and two which incorporate high-to-low load interaction, are studied. Three stress-stress intensity factor characterization approaches based on rms spectrum stress parameters are also examined. The results indicate that load interaction cycle by cycle accounting procedures lead to more accurate crack growth predictions principally because they incorporate the influence of the high-to-low load interaction phenomenon. The advantages of developing a bimodal rms stress characterization for transport-wing stress spectra are identified. (Author)

A74-26677 # Analysis of crack propagation under variable amplitude loading using the Willenborg retardation model. R. M. Engle and J. L. Rudd (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). *AIAA, ASME, and SAE, Structures, Structural Dynamics and Materials Conference, 15th, Las Vegas, Nev., Apr. 17-19, 1974, AIAA Paper 74-369*. 9 p. 11 refs. Members, \$1.50; nonmembers, \$2.00.

A74-26678 # Developing the 'backbone' of the F-14. C. Paez and T. Taglarine (Grumman Aerospace Corp., Bethpage, N.Y.). *AIAA, ASME, and SAE, Structures, Structural Dynamics and Materials Conference, 15th, Las Vegas, Nev., Apr. 17-19, 1974, AIAA Paper 74-371*. 9 p. Members, \$1.50; nonmembers, \$2.00.

This paper presents the major features in the development of high-performance, electron beam (EB) welded titanium structures emphasizing the detail design of high efficiency joints, material selection and processing. The selection of operating weld stresses and solution of associated EB welding problems are also discussed. Related test programs required to support this design effort, such as flaw growth rate testing, photoelastic model testing, and full-size static and fatigue development tests, are discussed at length. (Author)

A74-26679 # New alloys for advanced metallic fighter-wing structures. R. R. Wells (Northrop Corp., Aircraft Div., Hawthorne, Calif.). *AIAA, ASME, and SAE, Structures, Structural Dynamics and Materials Conference, 15th, Las Vegas, Nev., Apr. 17-19, 1974, AIAA Paper 74-372*. 9 p. Members, \$1.50; nonmembers, \$2.00. Contract No. F33615-72-C-1891. AF Project 486U.

This paper summarizes the materials test portion of a program sponsored by the U.S. Air Force Flight Dynamics Laboratory to develop lightweight/low-cost fighter-wing structures. Fatigue-crack propagation-rate curves are presented which compare aluminum alloys 7475-T7651, 7050-T73651, 7050-T7651 plates and 7050-T736 forgings, and titanium alloys Ti-6-4 beta-MA, Ti-6-2-1-1 A plates, Ti-6-4 A and STA castings, and Ti-6-22-22 STA forgings. Standard mechanical properties are also reported. For most aircraft applications, these new aluminum alloys appear better than 7075. Except for Ti-6-2-1-1 A plate and Ti-6-4 STA castings, the titanium alloys tested are better than conventional, wrought Ti-6-4 and Ti-6-6-2. (Author)

A74-26680 # Material selection and evaluation for advanced metallic aircraft structures. J. M. Shults (General Dynamics Corp., Convair Aerospace Div., Fort Worth, Tex.). *AIAA, ASME, and SAE, Structures, Structural Dynamics and Materials Conference, 15th, Las Vegas, Nev., Apr. 17-19, 1974, AIAA Paper 74-373*. 12 p. 15 refs. Members, \$1.50; nonmembers, \$2.00. Contracts No. F33615-72-C-1185; No. F33615-73-C-3001; No. F33615-72-C-2149.

Procedures used for material selection and evaluation have been developed and used for two advanced metallic structures, advanced development programs (AMS/ADP). The relationship of structural properties, and the role of fracture mechanics in material selection are discussed. The application of the selection criteria is explained as it was applied in selecting improved and advanced materials. A comparison of these advanced materials with other available materials is made using the selection criteria. The size and scope of

the materials evaluation test program is shown, and pertinent test results are reported. Design allowables for the selected materials are also presented. (Author)

A74-26682 # Material thickness control through process refinement. G. E. Knowles (Lockheed-Georgia Co., Marietta, Ga.). *AIAA, ASME, and SAE, Structures, Structural Dynamics and Materials Conference, 15th, Las Vegas, Nev., Apr. 17-19, 1974, AIAA Paper 74-375*. 10 p. Members, \$1.50; nonmembers, \$2.00.

Controlling the thickness of materials and coatings to more precise limits is an area that can yield increased vehicle performance through lowered weight at a minimum or no cost increase. Historically, the processing of materials has tended to produce thicknesses of parts above the nominal thickness dimension specified. The control of machined parts, rolled mill sheet, and chemically milled parts is discussed. Specific examples and means are given as to how increased control and closer to nominal thicknesses were obtained on the C-5A Program. The essential features of target establishment, communication of requirements, and process operator motivation are given. (Author)

A74-26683 # The growing procedural problems of washing mammoth aircraft. H. J. Singletary (Lockheed-Georgia Co., Marietta, Ga.). *AIAA, ASME, and SAE, Structures, Structural Dynamics and Materials Conference, 15th, Las Vegas, Nev., Apr. 17-19, 1974, AIAA Paper 74-376*. 3 p. Members, \$1.50; nonmembers, \$2.00.

Jumbo jets, like supertankers, are designed to carry larger payloads at less operational cost; yet many benefits can be challenged because of the magnitude of ground service requirements. The author discusses the efforts in progress today to overcome a major ground time consumer: aircraft cleaning. He focuses on the problems of available cleaning materials, equipment, and facilities as they relate to materials of construction in wide-bodied aircraft and to the environments which affect the cleaning capability/application of current technology. Whereas the author recommends an approach to a resolution, he expresses an opinion that many affected organizations have treated the subject of washing like fleas. They do little more than scratch. (Author)

A74-26687 # Adhesive bonding increases fatigue life of wing joint. E. E. House, Jr. and J. A. White (Lockheed-Georgia Co., Marietta, Ga.). *AIAA, ASME, and SAE, Structures, Structural Dynamics and Materials Conference, 15th, Las Vegas, Nev., Apr. 17-19, 1974, AIAA Paper 74-382*. 9 p. Members, \$1.50; nonmembers, \$2.00.

Aluminum doublers are adhesively bonded to exterior wing surfaces to improve fatigue resistance of primary wing bending structure. A heat curing film adhesive is used. Selection of the bonded doubler configuration is based on structural and design analysis, producibility demonstrations, and static and fatigue testing of specimens and components. Full-scale wing fatigue test articles were modified to the bonded configuration and are being fatigue cycled to substantiate performance predictions. Design allowables are developed on thick bond lines. Doublers are installed on aircraft after resolution of producibility problems and selection of nondestructive inspection methods. (Author)

A74-26700 * # A wind-tunnel investigation of a B-52 model flutter suppression system. L. T. Redd, J. Gilman, Jr. (NASA, Langley Research Center, Hampton, Va.); D. E. Cooley (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio), and F. D. Severt (Boeing Co., Wichita, Kan.). *AIAA, ASME, and SAE, Structures, Structural Dynamics and Materials Conference, 15th, Las Vegas, Nev., Apr. 17-19, 1974, AIAA Paper 74-401*. 7 p. 13 refs. Members, \$1.50; nonmembers, \$2.00.

Flutter modeling techniques have been successfully extended to the difficult case of the active suppression of flutter. The demon-

stration was conducted in a transonic dynamics tunnel using a 1/30 scale, elastic, dynamic model of a Boeing B-52 control configured vehicle. The results from the study show that with the flutter suppression system operating there is a substantial increase in the damping associated with the critical flutter mode. The results also show good correlation between the damping characteristics of the model and the aircraft. (Author)

A74-26701 # Active flutter suppression - A flight test demonstration. K. L. Roger, G. E. Hodges (Boeing Co., Wichita, Kan.), and L. Felt (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). *AIAA, ASME, and SAE, Structures, Structural Dynamics and Materials Conference, 15th, Las Vegas, Nev., Apr. 17-19, 1974, AIAA Paper 74-402.* 8 p. Members, \$1.50; nonmembers, \$2.00. Contract No. F33615-71-C-1926.

The first flight test demonstration of active flutter suppression has been successfully completed. The control configured vehicle B-52 test aircraft was twice flown 10 knots faster than its flutter speed relying solely on an automatic control system for adequate damping. The design, safety considerations, mechanization, ground testing, and flight testing of the flutter mode control system are reported. Comparisons between flight test and theoretical results are presented. The system was tested at heavy and light aircraft weights and tested for compatibility with simultaneous ride control, maneuver load control, fatigue reduction, and augmented stability. (Author)

A74-26702 * # A transonic study of active flutter suppression based on an aerodynamic energy concept. M. C. Sandford, I. Abel, and D. L. Gray (NASA, Langley Research Center, Hampton, Va.). *AIAA, ASME, and SAE, Structures, Structural Dynamics and Materials Conference, 15th, Las Vegas, Nev., Apr. 17-19, 1974, AIAA Paper 74-403.* 11 p. 9 refs. Members, \$1.50; nonmembers, \$2.00.

The application of active control technology to the suppression of flutter has been successfully demonstrated in the Langley transonic dynamics tunnel. This study involved the implementation of an aerodynamic-energy criterion to suppress flutter of a simplified delta-wing model. Use of this technique with both leading- and trailing-edge active controls has resulted in an increase in dynamic pressure of 22% above the basic wing flutter point and with only a trailing-edge active control has resulted in an increase in dynamic pressure of 30% above the basic wing flutter point at a Mach number of 0.9. Analytical methods used to predict the open- and closed-loop behavior of the model are also discussed. (Author)

A74-26703 # Suppression of flutter on interfering lifting surfaces by the use of active controls. E. Cwach (General Dynamics Corp., Convair Aerospace Div., Fort Worth, Tex.) and R. O. Stearnant (Texas University, Austin, Tex.). *AIAA, ASME, and SAE, Structures, Structural Dynamics and Materials Conference, 15th, Las Vegas, Nev., Apr. 17-19, 1974, AIAA Paper 74-404.* 11 p. 14 refs. Members, \$1.50; nonmembers, \$2.00. Grant No. AF-AFOSR-71-1998.

The active aerodynamic control concept was employed to recover flutter margins lost by the aerodynamic interference occurring on variable-geometry lifting surfaces. Analytical methods were developed to find a control law relating the motion of control surfaces to the motion of the main lifting surfaces, so that for given control surface geometries the maximum increase in flutter speed could be achieved. The methods were developed so that they could be applied to complex aircraft configurations. Analytical studies were carried out and found to be in agreement with the limited experimental data available. These studies demonstrate, for the range of parameters studied, that the active aerodynamic controls can be very effective in suppressing flutter on interfering lifting surfaces. (Author)

A74-26704 * # A comparison of two types of structural optimization procedures for satisfying flutter requirements. R. T. Haftka, J. H. Starnes, Jr. (NASA, Langley Research Center,

Hampton, Va.), and F. W. Barton (Virginia University, Charlottesville, Va.). *AIAA, ASME, and SAE, Structures, Structural Dynamics and Materials Conference, 15th, Las Vegas, Nev., Apr. 17-19, 1974, AIAA Paper 74-405.* 19 p. 16 refs. Members, \$1.50; nonmembers, \$2.00.

A comparison is made of results obtained from mathematical programming and optimality criteria procedures for the minimum-mass design of typical aircraft wing structures to satisfy prescribed flutter requirements. The mathematical programming method is based on an interior penalty function approach. A rigorous optimality criterion and an intuitive optimality criterion based on uniform strain energy density are considered. An intuitive resizing procedure is used for both optimality criterion solutions. All results are calculated using the same computer program, changing only the optimization procedure. Both high- and low-aspect-ratio wings are examined. Finite elements are used for structural modeling, and the generalized coordinates for the flutter solution are based on the natural vibration modes of the structure. (Author)

A74-26705 * # Some tunnel-wall effects on transonic flutter. C. L. Ruhlin (NASA, Langley Research Center, Aerelasticity Branch, Hampton, Va.), R. M. Destuynder (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France), and R. A. Gregory (Boeing Commercial Airplane Co., Seattle, Wash.). *AIAA, ASME, and SAE, Structures, Structural Dynamics and Materials Conference, 15th, Las Vegas, Nev., Apr. 17-19, 1974, AIAA Paper 74-406.* 8 p. 10 refs. Members, \$1.50; nonmembers, \$2.00.

Significant effects of wind-tunnel walls were observed on the transonic flutter boundaries of wall-mounted models during two flutter model research studies. In these studies, flutter experiments with cantilevered SST-type wing models were conducted in three different wind tunnels. The experimental results are compared to flutter boundaries calculated for the models in free air. The results indicate that transonic flutter boundaries can be affected by tunnel-wall interference, tunnel resonances, and shock-wave reflections, and that flutter model data accuracy is a function of model/tunnel size and tunnel wall porosity. However, models within the recommended size limits should give accurate results in transonic tunnels with normal ventilation. A flutter trend analysis for a two-dimensional wing-demonstrating tunnel wall and resonance effects on flutter are also presented. (Author)

A74-26708 # Buckling and failure of flat stiffened panels. S. Yusuff (West Virginia University, Morgantown, W. Va.). *AIAA, ASME, and SAE, Structures, Structural Dynamics and Materials Conference, 15th, Las Vegas, Nev., Apr. 17-19, 1974, AIAA Paper 74-409.* 12 p. 18 refs. Members, \$1.50; nonmembers, \$2.00.

A rational analysis which is self sufficient and comprehensive for computing the failing stresses of stiffened panels is presented. In the development of the formulas for computing the strength of all panels, the author's most recent results on the buckling of stiffened plates based on the energy method are significant. In addition to the review of the methods previously proposed, many other new results such as formulas for the maximum strength of stiffeners and panels and the application of the power law for determining the strength of panels are important. The analysis is adequately illustrated by examples and also compared with tests on 75S-T6 and 24S-T aluminum alloy Z-stiffened panels over a wide range of dimensions. It is shown that the analysis is in good agreement with tests. (Author)

A74-26711 # A unified engineering approach to the prediction of multiaxial fatigue fracture of aircraft structures. P. M. Toor (Lockheed-Georgia Co., Marietta, Ga.). *AIAA, ASME, and SAE, Structures, Structural Dynamics and Materials Conference, 15th, Las Vegas, Nev., Apr. 17-19, 1974, AIAA Paper 74-415.* 8 p. 16 refs. Members, \$1.50; nonmembers, \$2.00.

In this paper the existing biaxial fatigue theories are reviewed. The effect of isotropy, mean stress, phase angle, and notches on

biaxial fatigue is discussed. An approach based on equivalent stress is proposed. The exactness and consistency of this approach is verified with experimental results of full scale test articles. The analysis indicates that this simple approach can be used with confidence in predicting the linear cumulative damage in full scale structural components, which are experiencing multiaxial stress loading.

(Author)

A74-26713 * # Aeroelastic stability of periodic systems with application to rotor blade flutter. P. Friedmann and L. J. Silverthorn (California, University, Los Angeles, Calif.). *AIAA, ASME, and SAE, Structures, Structural Dynamics and Materials Conference, 15th, Las Vegas, Nev., Apr. 17-19, 1974, AIAA Paper 74-417*. 11 p. 17 refs. Members, \$1.50; nonmembers, \$2.00. Grant No. NGR-05-007-414.

The dynamics of a helicopter blade in forward flight are described by a system of linear differential equations with periodic coefficients. The stability of this periodic aeroelastic system is determined, using multivariable Floquet-Liapunov theory. The transition matrix at the end of the period is evaluated by: (1) direct numerical integration, and (2) a new, approximate method, which consists in approximating a periodic function by a series of step functions. The numerical accuracy and efficiency of the methods is compared, and the second method is shown to be superior by far. Results illustrating the effect of the periodic coefficients and various blade parameters are presented.

(Author)

A74-26714 # Effect of spanwise load-correlation on rotor blade flapping. F.-Y. M. Wan (MIT, Cambridge, Mass.). *AIAA, ASME, and SAE, Structures, Structural Dynamics and Materials Conference, 15th, Las Vegas, Nev., Apr. 17-19, 1974, AIAA Paper 74-418*. 12 p. 9 refs. Members, \$1.50; nonmembers, \$2.00. Army-supported research.

Second-order rigid flapping response statistics of lifting rotor blades have been obtained by efficient algorithms. These statistics make it possible to analyze the effect of a finite load correlation length on the blade response. If the advance ratio is small compared to unity, this effect can be concisely expressed in terms of an amplitude factor and a phase factor. In the case of a blade excited by a random vertical inflow with a spanwise correlation length of the order of the blade length, the amplitude factor shows that there may be as much as a 40% error in a solution which assumes that the inflow is spatially uniform.

(Author)

A74-26874 # Confidence assessment of military airframe cost predictions. D. P. Tihansky (RAND Corp., Santa Monica, Calif.). *Operations Research Society of America and Institute of Management Sciences, Joint National Meeting, Boston, Mass., Apr. 22-24, 1974, Paper*. 30 p. 21 refs.

Analysis of the degree of confidence that can be placed in cost predictions for airframes from standard cost models. Each airframe cost observation is partitioned into six components based on phases of the development or production cycle - e.g., flight test costs and manufacturing labor wages. Confidence measures are then compared for alternate model forms and for the use of a single regression on total costs versus the aggregation of regressions on component costs. Statistical theory is developed to test the independence of component models and to estimate predictive statistics for aggregated cost estimates.

(Author)

A74-26916 A two-component laser Doppler velocimeter for periodic flow fields. J. P. Sullivan and S. Ezekiel (MIT, Cambridge, Mass.). *Journal of Physics, Part E - Scientific Instruments*, vol. 7, Apr. 1974, p. 272-274. 5 refs. Contracts No. N0019-71-C-0220; No. F44620-69-C-0090; Grant No. DAAB07-71-C-0300.

A laser Doppler velocimeter system capable of measuring two-components of velocity in periodic flow fields has been developed. A sampling electronic system has been designed to handle the large fast fluctuations in velocity that are encountered in the

flow fields of interest. Examples of data from periodically produced vortex rings and a model helicopter rotor are presented. (Author)

A74-26948 Developing large-scale wavelike eddies and the near jet noise field. J. T. C. Liu (Imperial College of Science and Technology, London, England; Brown University, Providence, R.I.). *Journal of Fluid Mechanics*, vol. 62, Feb. 11, 1974, p. 437-464. 65 refs. NSF Grant No. GK-10008.

In this paper, we study the development of large-scale wavelike eddies, or instability waves, in a turbulent free shear flow. The model is based on splitting the flow into three components: the mean flow, the instability wave, and the fine-scale turbulence. The wave is considered to be sufficiently weak so that it is developing in a pre-existing, known turbulent mean shear flow. The basis for the wave development is its time-averaged kinetic energy flux equation in integral form, and the wave description is obtained through a shape assumption. The amplitude is determined by the energy equation; the shape function and local characteristics are determined by the local linear stability theory. The wave energy changes as it is convected into a different streamwise position where its instability properties change.

(Author)

A74-26960 On the flow field of a rapidly oscillating airfoil in a supersonic flow. M. Kurosaka (GE Research and Development Center, Schenectady, N.Y.). *Journal of Fluid Mechanics*, vol. 62, Feb. 27, 1974, p. 811-827. 11 refs.

Examination of the features of the flowfield off the surface of an oscillating flat-plate airfoil immersed in a two-dimensional supersonic flow. Although the exact linearized solution for a supersonic unsteady airfoil has been known for a long time, its expression in the form of an integral is not convenient for a physical interpretation. In the present study the quintessential features of the flowfield are extracted from the exact solution by obtaining an asymptotic expansion in descending powers of a frequency parameter through the repeated use of the stationary-phase and steepest descent methods. It is found that the flowfield consists of two dominant and competing signals: one is the acoustic ray or that component arising from Lighthill's 'convecting slab', while the other is the leading-edge disturbance propagating as a convecting wavelet.

(Author)

A74-26965 # Solid state vertical scale instruments. R. L. Skovholt (General Electric Co., Aircraft Equipment Div., Utica, N.Y.). *Society for Information Display, Proceedings*, vol. 15, 1st Quarter, 1974, p. 33-40. 6 refs. Contract No. N62269-71-C-0392.

Discussion of the design and development of a set of aircraft instruments which display engine parameters with the aid of red gallium arsenide phosphide light emitting diodes (LEDs), thus eliminating all moving parts. The instruments in question display rate of fuel flow, exhaust gas temperature, and fan speed in both vertical bar graph presentations and numerical readouts. It is shown how the parametric information from incoming sensor signals is extracted and translated into digital formats in order to interface conveniently with the control and driving circuitry that operate the LED displays. Two incandescent lamps are mounted in a diffuser block to illuminate the scale nomenclature and markings during dark ambient light conditions. The scale consists of different plexiglas materials to selectively transmit the wideband white and the monochromatic LED light.

A.B.K.

A74-27012 # Lockheed S-3A Viking - Electrical system with integrated drive generator. *Aircraft Engineering*, vol. 46, Mar. 1974, p. 7, 8.

The integrated drive generator is a simple but unique extension of the latest design concepts in constant speed drives and generators. It consists of the proven Sundstrand axial gear differential constant speed drive coupled with a Westinghouse spray oil-cooled generator. The drive mechanically converts the variable engine speed to constant generator speed, thus producing constant output frequency.

The integration of the drive and generator into an integrated drive generator involves physically mating the components through a more intimate interface, resulting in elimination of excess materials and seals and integrating the cooling of the generator with the constant speed drive oil system by spraying oil pumped from the drive onto the surface of the generator windings for more effective heat transfer.

F.R.L.

A74-27013 # Lockheed S-3A Viking - The integrated drive generator. *Aircraft Engineering*, vol. 46, Mar. 1974, p. 9, 10.

The integrated drive generator (IDG) is a simple 4-pole machine which rotates at a relatively low speed of 12,000 RPM, and has relatively low stress levels. The generator uses oil spray cooling which increases insulation life, eliminates all rotating oil seals, and increases the reliability of the spline and bearing. The expected reliability of the IDG is 30,000 hr mean time between failure (MTBF). The associated IDG controllers function only for control and protection and not power handling.

F.R.L.

A74-27014 # Lockheed S-3A Viking - Designing the auxiliary power unit to occupy ram air turbine generator space. *Aircraft Engineering*, vol. 46, Mar. 1974, p. 10, 11.

A74-27015 # Lockheed S-3A Viking - Combined flight control/utility system. *Aircraft Engineering*, vol. 46, Mar. 1974, p. 12-17.

The S-3A vehicle is equipped with two completely independent hydraulic systems which have been designated as the combined flight control/utility system. The combined flight control/utility system is supplied by the engine-driven pump on the No. 1 engine. During normal operation this system powers the dual servo flight control actuators, second side, the secondary flight control actuators, trailing edge flaps, the aircraft utility subsystems, and the auxiliary power unit starting system. The variable delivery pump, the filtration package, the selector valves and fuel tank pressurization regulator, transducers, servo controls, cable tension regulators, and the weapons bay door drive system are described.

F.R.L.

A74-27016 # Lockheed S-3A Viking - Air conditioning and pressurisation systems. *Aircraft Engineering*, vol. 46, Mar. 1974, p. 18-22.

The S-3A system consists of 50 components designed, manufactured, and integrated into a complete system by Garrett AiResearch. The system is basically a state-of-the-art system and was fully qualified prior to first aircraft flight. It has a unique capability of reducing bleed air consumption under certain conditions to improve aircraft endurance. This feature, specified by Lockheed, uses ram air to augment the reduced engine bleed air flow. The overall effect is improved engine efficiency which translates into extended endurance. The bleed air reduction is accomplished automatically whenever the ram air temperature is between 20 and 72 F and the aircraft is flying below 4000 ft.

F.R.L.

A74-27078 # Fatigue strength of an aluminum alloy in petroleum jet fuels at various temperatures (Tsiklicheskaia prochnost' aluminievogo splava v neftyanykh reaktivnykh toplivakh pri razlichnykh temperaturakh). A. V. Karlashov and I. I. Priakhin (Kievskii Institut Inzhenerov Grazhdanskoi Aviatsii, Kiev, Ukrainian SSR). *Fiziko-Khimicheskaya Mekhanika Materialov*, vol. 10, no. 1, 1974, p. 24-27. 9 refs. In Russian.

A74-27095 The Ioran C procedure (Das Ioran C - Verfahren). U. Hammerschmidt (Deutsches Hydrographisches Institut, Hamburg, West Germany). *Ortung und Navigation*, no. 4, 1973, p. 27, 29-52. In German.

Developments in the field of radionavigation systems are briefly

reviewed, giving attention to difficulties with the standard Ioran system and approaches used by Cytac to overcome these difficulties. Further improvement of the early Cytac system led to the present Ioran C. A carrier frequency of 100 kHz is used by Ioran C and periodic pulse trains are emitted. These pulse trains consist of 9 pulses in the case of the master station and of 8 pulses in the case of the slave stations. Operational details of Ioran C are discussed along with pulse repetition rates, details regarding the Ioran C receivers, and possible disturbances in operation and reception.

G.R.

A74-27097 The aeronautical aspects of an employment of Ioran C and Omega (Die aeronautischen Aspekte der Anwendung von Ioran C und Omega). Mr. Kapp (Deutsche Lufthansa AG, Frankfurt am Main, West Germany). *Ortung und Navigation*, no. 4, 1973, p. 85-91. In German.

Problems of global radionavigation are examined, giving attention to the Inertial Navigation System (INS). An investigation is conducted concerning the possibilities for a replacement of INS by Omega and Ioran C. Questions regarding the exchange of Omega and INS devices are considered. The Omega system can provide global coverage. An exclusive use of the Omega system has, however, a number of disadvantages. Global coverage cannot be obtained by the employment of Ioran C. The employment of Omega and Ioran C in conjunction with INS is also discussed.

G.R.

A74-27098 Aeronautical aspects of the employment of Omega and Ioran C in general aviation (Aeronautische Aspekte der Anwendung von Omega und Ioran C in der allgemeinen Luftfahrt). J. Gestlauer. *Ortung und Navigation*, no. 4, 1973, p. 93-95. In German.

Neither Omega nor Ioran C is currently widely used in general aviation in spite of the potential advantages inherent in an employment of the two systems in general aviation. This situation is due to the fact that the presently available equipment is not suitable for general aviation aircraft because of device complexity, high cost, large size, and weight considerations. Navigation devices which could be used in general aviation are considered.

G.R.

A74-27137 Navy's Fleet Satellite and GAFILLER Satellite Communications programs. J. L. Boyes and T. H. Harden (U.S. Navy, Washington, D.C.). *Signal*, vol. 28, Mar. 1974, p. 10, 11, 14, 16, 17.

Review of the evolution stages of the recent past, present, and near future in naval telecommunications, with special attention to the significance of the changes to be brought about by the introduction of the Navy's Fleet Satellite Communications (FLT-SATCOM) and 'GAFILLER' Satellite Communications Systems. These systems are shown to herald the advent of an era that will see relay by geosynchronous communications satellites supersede high frequency radio as the principal transmission medium for communicating with ships and aircraft at sea. FLTSATCOM is planned for the decade commencing in 1976, whereas the GAFILLER refers to a limited, interim space relay service the Navy will lease from COMSAT Corporation until the FLTSATCOM spacecraft are operational.

M.V.E.

A74-27210 # The Instrument Landing System for category I, II, and III operation (Das Instrumentenlandesystem für die Betriebsstufen I, II und III). W. Trempler (Gesellschaft für internationalen Flugverkehr mbH, Berlin, East Germany). *Technisch-ökonomische Informationen der zivilen Luftfahrt*, vol. 10, no. 1, 1974, p. 4-14, 23. 7 refs. In German.

The most important Instrument Landing System (ILS) parameters are discussed, and the three operating categories as defined by the ICAO are described. The implementation of category II systems in all major world airports is advocated, as a new generation of ILS systems is available which can operate at categories II and III. The economical considerations in changeovers to category II or III systems are discussed.

P.T.H.

A74-27211 # Technology of passenger clearance in air transportation using various clearance methods (Technologie der Passagierabfertigung im Luftverkehr bei verschiedenen Abfertigungsmethoden). P. Franke (Hochschule für Verkehrswesen, Dresden, East Germany) and V. Podshipkov (Akademie für Zivilluftfahrt der UdSSR, Leningrad, USSR). *Technisch-ökonomische Informationen der zivilen Luftfahrt*, vol. 10, no. 1, 1974, p. 15-23. In German.

The so-called ground time often consumes a good deal of the flight time saved by faster and larger aircraft. The present work classifies and analyzes the practicable passenger clearance methods. The two principal classifications are line-wise clearance, in which the passenger reports to a counter used exclusively by the airline on which he is flying, and free clearance, in which all passengers, regardless of the airline which they are flying, can be cleared at any counter. A method for calculating important parameters in the evaluation of either method is described. P.T.H.

A74-27252 Flight control system advances for near-future military aircraft. P. E. Blatt (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). *Society of Automotive Engineers, Committee A-6 Meeting, San Diego, Calif., Oct. 24, 1973, Paper 730987*. 11 p. 12 refs. Members, \$1.25; nonmembers, \$2.00.

Advanced flight control concepts are reviewed that are expected to result in major design changes in total vehicle configuration and to significantly improve the overall mission effectiveness of near-future military aircraft. Fly-by-wire (FBW) controls have been the catalyst which makes these advances possible. Analog fly-by-wire controls are now considered fully qualified with the successful completion of the 680J Survivable Flight Control System flight test program. The major thrust of flight control developments is now in the digital control field. Unique advantages are attributable to digital controls, and the latter are now competitive with analog controls. Emphasis is being placed on cost-conscious technology developments. Design-to-cost constraints will have a major impact on future flight control designs. M.V.E.

A74-27253 Fluid power and control requirements for the U.S. Army heavy lift helicopter. T. P. Pepler (Boeing Vertol Co., Philadelphia, Pa.). *Society of Automotive Engineers, Committee A-6 Meeting, San Diego, Calif., Oct. 24, 1973, Paper 730988*. 11 p. Members, \$1.25; nonmembers, \$2.00.

Summary of the development program of the U.S. Army heavy-lift helicopter fly-by-wire flight control system. The evolved system consists of a triple channel direct electrical linkage which replaces the mechanical controls between the cockpit and the rotor control actuators and a triplex digital automatic flight control system. The direct electrical linkage has been successfully tested in a demonstration helicopter. The test helicopter utilized triple hydraulic driver actuators to control existing power actuators. In the heavy lift helicopter, the driver and power functions will be integrated into a single rotor control actuator consisting of a triple control stage and dual power stage. M.V.E.

A74-27255 Advance airborne system for maintenance monitoring. B. M. Meador and J. F. Nemecek (Trans World Airlines, Inc., New York, N.Y.). *Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, Los Angeles, Calif., Oct. 16-18, 1973, Paper 730955*. 12 p. Members, \$1.25; nonmembers, \$2.00.

In-flight performance monitoring of aircraft has become a valuable time-and cost-saving tool for the airlines over the last few years. The development of such techniques on TWA's DC-9, 747, and L-1011 aircraft is described. The aircraft integrated data system has been the basis of TWA's maintenance monitoring. Initially installed in 1966 on the DC-9, the system was later expanded to the jumbo jets. The parameters monitored, the computer interlocks, and the maintenance scheduling which results are described. Specific examples solved via these techniques are given. (Author)

A74-27256 * The influence of engine technology advancements on aircraft economics. J. W. Witherspoon and W. O. Gaffin (United Aircraft Corp., Pratt and Whitney Aircraft Div., Middletown, Conn.). *Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, Los Angeles, Calif., Oct. 16-18, 1973, Paper 730960*. 6 p. 5 refs. Members, \$1.25; nonmembers, \$2.00. NASA-supported research.

A technology advancement in a new powerplant has both favorable and unfavorable effects. Increased bypass ratio and compression ratio, coupled with high turbine temperatures, improve performance but also increase engine price and maintenance cost. The factors that should be evaluated in choosing an engine for airline use are discussed. These factors are compared for two engines that might be considered for future 150 to 200 passenger airplanes: an all-new turbofan and a quiet derivative of an existing first generation turbofan. The results of the performance and cost evaluations of the example engines are reduced to common units so they can be combined. F.R.L.

A74-27257 Aircraft engine and accessory drives and flange standards. *SAE Aerospace Information Report, AIR 1160 A*, Nov. 30, 1973. 8 p.

The purpose of the standard is to provide the means by which both engine manufacturers and accessory manufacturers may save appreciable design and development time by utilizing the collective and coordinated efforts and the past experience of the industry in solving the problems of tolerance and performance capability. Another purpose is to assure, by simple identification designation, design compatibility between engine pads and drives and accessory flanges and drive shafts. All pertinent parts of a 'standard' are briefly described. F.R.L.

A74-27259 Helicopter and V/STOL aircraft noise measurement problems. *SAE Aerospace Information Report, AIR 1286*, Apr. 1973. 5 p.

The noise signatures of vertical and short takeoff and landing (V/STOL) aircraft can differ substantially from those of conventional takeoff and landing (CTOL) aircraft for which measurement procedures have been standardized. An attempt is made to review the more important factors associated with the measurement of external noise of V/STOL aircraft and to provide general guidance for the acquisition and analysis of such data. Problem areas and instrumentation requirements are discussed. F.R.L.

A74-27261 Instrumentation and cockpit controls for electronic navigation and communication aids. *SAE Aerospace Recommended Practice, ARP 571 B*, May 25, 1973. 7 p.

This document presents a recommended standard for commercial transport, detailing the manner in which information from electronic navigation and communication aids are portrayed in the cockpit. It also recommends a standard arrangement for the cockpit controls used to operate and receive information from this equipment. The basic factors considered include: ability of the crew to use the equipment, flexibility combined with safety to provide optimum use of the equipment, degree of accuracy necessary, simplicity, and economy of the installation. (Author)

A74-27262 Ball type slave bearings for rotor support in dynamic balancing machines. *SAE Aerospace Recommended Practice, ARP 1202*, July 1973. 3 p.

A74-27263 Nomenclature and abbreviations, flight deck area. *SAE Aerospace Standard, AS 425 B*, June 1, 1973. 24 p.

A74-27264 Portable chemical oxygen. *SAE Aerospace Standard, AS 1303*, May 1973. 5 p.

The specification applies to a chemical oxygen generator

assembly for the following uses: (1) first aid treatment of passenger cabin occupants after emergency descent, and (2) by cabin attendants to maintain their mobility after cabin decompression. The assembly must provide a minimum flow rate of four liters of oxygen per minute, standard temperature, standard pressure, dry, from one or more generator cartridges for a minimum time when operating at an ambient temperature of 80 F. Performance and environmental requirements are specified. F.R.L.

A74-27266 Potentials for advanced civil transport aircraft /Third William Littlewood Memorial Lecture/. E. C. Wells (Boeing Co., Seattle, Wash.). Research sponsored by the American Institute of Aeronautics and Astronautics and Society of Automotive Engineers. New York, Society of Automotive Engineers, Inc. (SAE-SP-385), 1973. 14 p. \$5.00.

A review of Boeing commercial transport models is presented in chronological order from the 8-1 flying boat of 1919 to the 747. The problems of air transport systems including convenience, reliability, safety, comfort, performance, and financial and environmental costs are discussed. The probability of more severe future problems is considered, and suggestions are offered with regard to technology and system improvements which may need to be pursued if civil air transport systems are to continue to provide fast, convenient transportation with a high level of public acceptance. A brief discussion of subsonic vs supersonic transport acceptability points out that availability in the foreseeable future of the technology it would take to make the SST acceptable is just not in sight, while for the subsonic transport enough avenues of improved technology now seem to be open for achieving the highest standards of acceptance. M.V.E.

A74-27267 # Sonic fatigue failure mechanisms in potential Space Shuttle Orbiter panel designs. E. F. Baird, M. Bernstein, and N. Arcas (Grumman Aerospace Corp., Bethpage, N.Y.). *AIAA, ASME, and SAE, Structures, Structural Dynamics and Materials Conference, 15th, Las Vegas, Nev., Apr. 17-19, 1974, AIAA Paper 74-348*. 9 p. Members, \$1.50; nonmembers, \$2.00.

Sonic fatigue was a significant factor in Grumman's proposed shuttle structural design. A test program undertaken to supplement the analysis included two types of corrugated panels suitable for cargo bay doors, two types of hat stiffened panels, and one fully machined panel suitable for regions in the orbiter wing and fuselage. Mode surveys determined the deformation patterns, resonant frequencies, and damping. After early failures in one of the corrugated panels, the number of clips between frames and stiffeners was increased, a bonding agent was added during assembly and simulated TPS tiles were added. The total life for the improved panel (270 minutes) was still below the 330 minute target. The hat-stiffened panel redesigned after initial early failure successfully passed the target test period. The fully machined design panel survived for 290 minutes, achieving 88% of the target life. (Author)

A74-27293 # Aircraft on-board equipment for dynamic measurements with piezoelectric sensors (Lotnicza pokładowa aparatura do pomiarów dynamicznych z czujnikami piezoelektrycznymi). R. Kudelski and W. Zabkiewicz (Instytut Techniczny Wojsk Lotniczych, Warsaw, Poland). *Technika Lotnicza i Astronautyczna*, vol. 29, Jan. 1974, p. 15-18. 5 refs. In Polish.

Description of piezoelectric linear-acceleration sensors and associated electronics comprising a system for in-flight vibration measurements of aircraft structural elements. Equivalent and schematic circuit diagrams are given for the sensors, sensor leads, an FET-input preamplifier, and an output amplifier based on an IC differential amplifier chip. Curves illustrate response and performance characteristics over a 0 to 1000 Hz frequency range of mechanical vibration. T.M.

A74-27295 # Use of containers and pallets in air cargo transport (Zastosowanie kontenerów i palet w lotniczym transporcie towarowym). M. Kawczynski and R. Szopski. *Technika Lotnicza i Astronautyczna*, vol. 29, Feb. 1974, p. 6-14. In Polish.

The use of containers and pallets reduces packaging costs, simplifies transport, and provides greater protection against theft and damage. The advantages and limitations of this form of cargo transport are evaluated, and the containerization program adopted by IATA in 1963 is outlined in terms of major goals and container design specifications. The program adopted at the 1969 IATA conference in Athens is similarly explained. The air cargo transport procedures currently used in Polish aviation are discussed along with prospects for adopting IATA standard containers and pallets in the Polish LOT airline operations. T.M.

A74-27296 # Noise measurements of the jet and piston engines on the Lala-1 experimental airplane (Pomiary hałasu silnika odrzutowego i tłokowego w samolocie doświadczalnym Lala-1). A. Rudiuk. *Technika Lotnicza i Astronautyczna*, vol. 29, Feb. 1974, p. 15-17. In Polish.

Results of noise measurements conducted on the ground and in the cabin of an experimental agricultural biplane Lala-1 during operation of either a jet engine or a piston engine on the aircraft. The locations and mounting of the two engines differed, and the measurements served not for purposes of strict comparison but as a basis for evaluating noise reduction possibilities offered by a jet engine. Isosonic curves and curves of amplitude vs frequency (31.5 Hz to 31.5 kHz) are illustrated for both engines. T.M.

A74-27297 # Propellers at present and in the future (Smigła obecnie i w przyszłości). Z. Brodzki. *Technika Lotnicza i Astronautyczna*, vol. 29, Feb. 1974, p. 18, 25-29, 40. 7 refs. In Polish.

Geometrical, structural, and control requirements which must be met by the propellers used in STOL turboprop aircraft are identified. Emphasis is placed on the features of new design solutions, including details of novel propeller shaft drives, dual propellers, spinners, and shrouded propellers. T.M.

A74-27343 # Influence of the method of hole machining on the fatigue strength of aircraft structural materials (Vliyanie metoda obrabotki otverstii na soprotivlenie ustalostnomu razrusheniiu materialov aviatsionnykh konstruktsii). A. M. Rozenberg, O. A. Rozenberg, and V. I. Mal'nev (Akademiia Nauk Ukrainsskoi SSR, Institut Sverkhtrverdnykh Materialov, Kiev, Ukrainian SSR). *Problemy Prochnosti*, vol. 6, Feb. 1974, p. 109-111. In Russian.

A74-27363 # Noise limit values in the case of aircraft (Lärmgrenzwerte bei Luftfahrzeugen). F. K. Franzmeyer (Luftfahrt-Bundesamt, Braunschweig, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Symposium über Triebwerkslärm, Braunschweig, West Germany, Feb. 20, 21, 1974, Paper 74-015*. 18 p. 10 refs. In German.

A German law states that the technical equipment of an aircraft should be designed in such a way that the noise produced by its operation is not greater than the noise level which is inevitable according to current technological standards. The implementation of this law is discussed, giving attention to the approaches used for determining the noise limits considered by the law. Details of noise measurements are also examined, taking into account the points at which the noise is to be measured and the flight procedure required for the measurements. Noise limit values specified in international regulations are also discussed. G.R.

A74-27364 Noise phenomena in the case of helicopter rotors and possibilities for noise reduction (Lärmerscheinungen bei Hubschrauberrotoren und Möglichkeiten zur Lärminderung). V. Langenbacher (Messerschmitt-Bölkow-Blohm GmbH, Ottobrunn,

(West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Symposium über Triebwerkslärm, Braunschweig, West Germany, Feb. 20, 21, 1974, Paper 74-024*. 17 p. 20 refs. In German.

Questions of noise emission in the case of helicopter rotors are investigated, giving attention to the origin of the sound effects. Possibilities for noise reduction are explored, taking into account the aerodynamic noise sources at the rotor blade. The configuration properties are an important factor in an efficient approach to reduce the noise level. Helicopters which produce little noise could be built. However, some of the approaches for reducing noise result in a reduction of operational efficiency. The results presented show the effect of the number of revolutions, thrust, and profile curvature on rotor noise. G.R.

A74-27365 Systematic investigations in the field of noise shielding (Systematische Untersuchungen auf dem Gebiet der Schallabschirmung). H. H. Hölscher (Messerschmitt-Bölkow-Blohm GmbH, Hamburg, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Symposium über Triebwerkslärm, Braunschweig, West Germany, Feb. 20, 21, 1974, Paper 74-021*. 30 p. 12 refs. In German. Research supported by the Bundesministerium für Forschung und Technologie.

For the design of jet aircraft with low noise characteristics, noise emission levels must be computed in advance or they must be determined with the aid of model experiments. Measurements were conducted at sound-hard and sound-soft surfaces with one, two, and three straight diffracting edges and a round edge, taking into account conditions at various distances from the shielding surface. The values obtained differ considerably from data of other authors. These differences can be partly explained by the fact that the presently reported measurements have been conducted in a reflectionless room and not in the open air as those of most other authors. G.R.

A74-27366 # Quieter propellers for general aviation - Present situation, future outlook (Leisere Propeller für die allgemeine Luftfahrt - Gegenwärtige Situation, Zukunftserwartung). R. Hoffmann and G. Mühlbauer (Propellerwerk Hoffmann GmbH und Co., Rosenheim, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Symposium über Triebwerkslärm, Braunschweig, West Germany, Feb. 20, 21, 1974, Paper 74-023*. 17 p. 9 refs. In German.

The problems involved in meeting recent noise limit regulations for propeller-driven aircraft are discussed. The propeller can be reduced to its minimum repair radius, which in most cases amounts to only a 2 to 3% reduction. The blade tips can be rounded in some cases. With these modifications in effect, a 2 to 3 dBA reduction can be obtained, although performance characteristics of the motor/propeller unit may suffer. In general, large propellers at low rpm are quieter and give a better thrust gain than smaller propellers at higher rpm. It is advocated that in-depth studies be initiated to study the effect of geometry of the propeller on the noise level. P.T.H.

A74-27367 # Comments concerning noise indices /results of the study of aircraft noise in Munich conducted by the German Research Community are taken into account/ (Einige Bemerkungen über Lärmindizes /mit Berücksichtigung der Ergebnisse der Münchener Fluglärmuntersuchung der deutschen Forschungsgemeinschaft/). K. Matschat, E.-A. Müller, and G. Zimmermann (Max-Planck-Institut für Strömungsforschung, Göttingen, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Symposium über Triebwerkslärm, Braunschweig, West Germany, Feb. 20, 21, 1974, Paper 74-014*. 4 p. 6 refs. In German.

In connection with the planning of noise-protection measures, the problem arises to characterize the average disturbance produced by a noise event lasting hours or days. Such a characterization is provided by the noise index. Noise indices frequently used include the 'Noise and Number Index' and the 'Noise Exposure Forecast Value'. The determination of noise indices is considered, giving

attention to a number of important concepts. The mean value of intensity is discussed together with the fluctuation concept and questions of a general frequency evaluation. G.R.

A74-27411 * # Calculation procedures for potential and viscous flow solutions for engine inlets. J. A. Albers and N. O. Stockman (NASA, Lewis Research Center, V/STOL Propulsion Technology Branch, Cleveland, Ohio). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Zurich, Switzerland, Mar. 30-Apr. 4, 1974, Paper 74-GT-3*. 8 p. 23 refs. Members, \$1.00; nonmembers, \$3.00.

The method and basic elements of computer solutions for both potential flow and viscous flow calculations for engine inlets are described. The procedure is applicable to subsonic conventional, short-haul, and vertical takeoff aircraft engine nacelles operating in a compressible viscous flow. The calculated results compare well with measured surface-pressure distributions for a number of model inlets. The uses of the program in both the design and analysis of engine inlets are discussed, with several examples given for VTOL lift fans, acoustic splitters, and for STOL engine nacelles. Several test support applications are also given. (Author)

A74-27418 # Real-time simulation of jet engines with digital computer. K. Nishio and N. Sugiyama (National Aerospace Laboratory, Tokyo, Japan). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Zurich, Switzerland, Mar. 30-Apr. 4, 1974, Paper 74-GT-19*. 12 p. 7 refs. Members, \$1.00; nonmembers, \$3.00.

This paper describes the configuration and some programming techniques of a real-time digital simulator of jet engines, along with some comparisons between the simulation test results and actual engine test data. The simulator consists of a minicomputer with memory capacity of 8192 words and an add time of 1.92 microsec, CRT display, A-D, D-A converters and other peripherals. The programming of the digital computer is aimed at high flexibility to the change of simulated engine forms and rapid convergence of the matching calculation among engine components. (Author)

A74-27419 # The aerodynamics of a turbine cascade with supersonic discharge and trailing edge blowing. I. P. MacMartin and J. F. Norbury (Liverpool, University, Liverpool, England). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Zurich, Switzerland, Mar. 30-Apr. 4, 1974, Paper 74-GT-120*. 15 p. 11 refs. Members, \$1.00; nonmembers, \$3.00. Research supported by the Science Research Council and Rolls-Royce, Ltd.

This paper presents a very thorough experimental investigation of a supersonic turbine cascade with thick trailing edges designed for trailing edge ejection of cooling air. Experiments were performed on a supersonic turbine cascade designed for a deflection of 135 deg and outlet Mach number 1.2. The blade section was designed for high rates of cooling air flow, the cooling air being ejected through a slot in a relatively thick trailing edge. Results were obtained for both the blown cascade and the equivalent cascade with solid trailing edges. The flow was found to be substantially different from that assumed in the design method, the effect of reduced base pressure at the trailing edges being especially important. Theoretical considerations lead to an improved model of the flow. (Author)

A74-27422 # A model of two-dimensional, incompressible flow through a cascade of airfoils with allowance for the viscous displacement effect. D. A. Firth (Department of Supply, Aeronautical Research Laboratories, Melbourne, Australia). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Zurich, Switzerland, Mar. 30-Apr. 4, 1974, Paper 74-GT-126*. 14 p. 9 refs. Members, \$1.00; nonmembers, \$3.00.

A74-27426 # Lift and moment prediction for an oscillating airfoil with a moving separation point. F. Sisto and P. V. K. Perumal (Stevens Institute of Technology, Hoboken, N.J.). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Zurich, Switzerland, Mar. 30-Apr. 4, 1974, Paper 74-GT-28*. 7 p. 12 refs. Members, \$1.00; nonmembers, \$3.00. Contract No. N00014-67-A-0202-0016.

A74-27432 # Recent status on development of the turbofan engine in Japan. M. Matsuki, T. Torisaki (National Aerospace Laboratory, Tokyo, Japan), and K. Miyazawa (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Zurich, Switzerland, Mar. 30-Apr. 4, 1974, Paper 74-GT-39*. 12 p. Members, \$1.00; nonmembers, \$3.00.

Efforts to design and develop new jet engines have been made in Japan since 1953. One family of propulsion engine (J3) succeeded in getting into production for installation on two models of Japanese developed aircraft (T1B and P2J). Another family of lift engine (JR) has been successfully used for overall VTOL system studies. Based upon these experiences, studies on a new fan engine for main propulsion are being carried out. This new engine (FJR-710) is a high bypass front fan engine developed for low noise generation and low smoke emission. (Author)

A74-27433 # Supersonic unstalled flutter in fan rotors - Analytical and experimental results. L. E. Snyder and G. L. Commerford (United Aircraft Corp., East Hartford, Conn.). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Zurich, Switzerland, Mar. 30-Apr. 4, 1974, Paper 74-GT-40*. 8 p. 18 refs. Members, \$1.00; nonmembers, \$3.00. Contract No. N00019-72-C-0187.

Supersonic unstalled flutter is predicted using an unsteady supersonic cascade analysis, a cascade wind tunnel, and a high speed fan rotor. Since the unsteady analysis assumes thin flat plate airfoils, the effect of thickness and blade shape was examined experimentally by flutter testing two sets of supersonic blading in a cascade wind tunnel. The effects of changes in Mach number, reduced frequency, stagger angle, and interblade phase angle were examined from the analysis and tests. Results show that the trends are in agreement, but that blade shape has an effect on the level of reduced velocity at the incipient flutter point. The unsteady aerodynamic analysis is applied to two transonic fan stages. Results of the fan tests show that the analysis correctly predicts the susceptibility to flutter of each rotor. (Author)

A74-27439 * # Holographic studies of shock waves within transonic fan rotors. W. A. Benser, E. E. Bailey, and T. F. Gelder (NASA, Lewis Research Center, Cleveland, Ohio). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Zurich, Switzerland, Mar. 30-Apr. 4, 1974, Paper 74-GT-46*. 9 p. 10 refs. Members, \$1.00; nonmembers, \$3.00. NASA-supported research.

NASA has funded two separate contracts to apply pulsed laser holographic interferometry to the detection of shock patterns in the outer span regions of high tip speed transonic rotors. The first holographic approach used ruby laser light reflected from a portion of the centerbody just ahead of the rotor. These holograms showed the bow wave patterns upstream of the rotor and the shock patterns just inside the blade row near the tip. The second holographic approach, on a different rotor, used light transmitted diagonally across the inlet annulus past the centerbody. This approach gave a more extensive view of the region bounded by the blade leading and trailing edges, by the part span shroud and by the blade tip. These holograms showed the passage shock emanating from the blade leading edge and a moderately strong conical shock originating at the intersection of the part span shroud leading edge and the blade suction surface. (Author)

A74-27442 # Simulation study of transient performance matching of turbofan engine using an analogue computer to evaluate its usefulness as design tool. M. Itoh, T. Ishigaki, and Y. Sagiya (Ishikawajima-Harima Heavy Industries, Co., Ltd., Tokyo, Japan). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Zurich, Switzerland, Mar. 30-Apr. 4, 1974, Paper 74-GT-50*. 6 p. Members, \$1.00; nonmembers, \$3.00.

A74-27444 # Residual stresses in gas turbine engine components from Barkhausen noise analysis. J. R. Barton and F. N. Kusenberger (Southwest Research Institute, San Antonio, Tex.). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Zurich, Switzerland, Mar. 30-Apr. 4, 1974, Paper 74-GT-51*. 9 p. 22 refs. Members, \$1.00; nonmembers, \$3.00.

A74-27445 # The dynamic stability of wing-mounted engine installations for turboprop-powered aircraft. D. J. Tree, R. G. Alderson, J. W. Harvey, and D. R. Mason (AiResearch Manufacturing Company of Arizona, Phoenix, Ariz.). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Zurich, Switzerland, Mar. 30-Apr. 4, 1974, Paper 74-GT-52*. 7 p. Members, \$1.00; nonmembers, \$3.00.

A74-27447 # Torsional stability analysis of a gas-turbine powered helicopter drive system. M. S. Darlow (Mechanical Technology, Inc., Latham, N.Y.) and J. M. Vance (Florida, University, Gainesville, Fla.). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Zurich, Switzerland, Mar. 30-Apr. 4, 1974, Paper 74-GT-54*. 7 p. 9 refs. Members, \$1.00; nonmembers, \$3.00. Army-supported research.

The torsional stability of a closed-loop dynamic system is evaluated. The system is a typical transport helicopter speed governor, gas-turbine engine, and drive train. This system is compared with the stability of a similar system in which a nonlinear coupling is included in the drive train, to determine if the coupling will increase the torsional stability of the system. This nonlinear coupling is designed to isolate torsional vibrations in the rotor. The two systems are first linearized, using a decoupled rotor model for the ZTS coupling, and are expressed in the form of Laplace transfer functions. Then a Bode analysis is performed and gain and phase margins are compared for the two systems. The nonlinear systems are numerically simulated to determine the time response and frequency response to excitation. The ZTS coupling design considered is found to be effective in stabilizing the previously unstable helicopter drive system. (Author)

A74-27452 # Parameter selection for multiple fault diagnostics of gas turbine engines. L. A. Urban (United Aircraft Corp., Hamilton Standard Div., Windsor Locks, Conn.). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Zurich, Switzerland, Mar. 30-Apr. 4, 1974, Paper 74-GT-62*. 6 p. Members, \$1.00; nonmembers, \$3.00.

An introduction to the fundamentals of turbine engine multiple fault diagnosis and its relationship to engine parameter selection and measurement requirements is presented. The effects of the type (thermodynamic cycle) of the engine to be diagnosed, and the nature of its expected problems, on the required parameters and the attendant measurement repeatability requirements are discussed. (Author)

A74-27466 # A model of convex programming for turbojet main parameter selection optimization. C. Turcanu (Institutul de Mecanica a Fluidelor si Constructii Aerospatiale, Bucharest, Rumania). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Zurich, Switzerland, Mar. 30-Apr. 4, 1974, Paper 74-GT-79*. 6 p. Members, \$1.00; nonmembers, \$3.00.

A mathematical modeling of well-known methods used to define turbojet main parameters, aiming at solution optimization, is

described. The parameters considered include: compression ratio, maximum temperature for turbine, compressor efficiency, turbine efficiency, and others. A function representing a sum of the ratios describing specific thrust and SFC deviations against maximum specific thrust and minimum SFC, respectively, is derived. Main parameter selection criteria pending on engine operation conditions and aircraft category are introduced. Mathematical analysis for main parameter selection optimization leads to a convex programming model for which both the function and the constraints are convex functions defined by convex fields. (Author)

A74-27467 # Some results from tests on a high work axial gas generator turbine. U. Okapuu (United Aircraft of Canada, Ltd., Longueuil, Quebec, Canada). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Zurich, Switzerland, Mar. 30-Apr. 4, 1974, Paper 74-GT-81*. 11 p. 6 refs. Members, \$1.00; nonmembers, \$3.00. Research sponsored by the Canadian Defence Research Board and United Aircraft of Canada.

Aerodynamic test results are presented for a single-stage, axial gas generator turbine of 3.9:1 design pressure ratio. Test results are also shown for a number of variants on this design, indicating the effect on aerodynamic performance of degree of reaction, nozzle and rotor aspect ratio, rotor blade channel design, rotor tip clearance, radial work distribution, and effect of nozzle end-wall contouring. Detailed aerodynamic observations are compared with analytical predictions. Of the design parameters examined, rotor blade aspect ratio, tip clearance, and channel diffusion were found to have the greatest influence on losses. Operation at pressure ratios above the design was found to be improved with 'open' rotor stagger, yielding a reduced design-point degree of reaction. (Author)

A74-27468 # An automated interactive design system for advanced gas turbines. K. M. Thomas and J. J. Piendel (United Aircraft Corp., Pratt and Whitney Aircraft Div., East Hartford, Conn.). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Zurich, Switzerland, Mar. 30-Apr. 4, 1974, Paper 74-GT-82*. 12 p. Members, \$1.00; nonmembers, \$3.00.

In the past ten years there has been a dramatic increase in turbine inlet temperature in aircraft gas turbine engines. This increase has been made possible by the application of extensive air cooling to turbine parts. The attendant increase in turbine design complexity without an increase in engine design or development time has been made possible by the development of modern computers and computer programs. A computerized turbine automated design system (TADSYS) developed at Pratt and Whitney Aircraft makes extensive use of computer graphics to meet the needs of modern turbine design. (Author)

A74-27469 # NEPCOMP - The Navy Engine Performance Program. S. R. Shapiro and M. J. Caddy (U.S. Naval Material Command, Naval Air Development Center, Warminster, Pa.). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Zurich, Switzerland, Mar. 30-Apr. 4, 1974, Paper 74-GT-83*. 7 p. 7 refs. Members, \$1.00; nonmembers, \$3.00.

A general-purpose computer program is described which permits rapid design point and off-design performance analyses of air-breathing engines. The modular approach used in building the overall program allows analysis of many engine configurations, including multistream, multinozzle, augmented engines; shaft engines; and ramjets. The program may be operated with or without component maps. The result is a computational tool that can be used to perform independent analyses of an engine manufacturer's product, as well as provide engine performance data for use in engine-airframe design and integration studies. (Author)

A74-27472 # Study of casing treatment effects in axial flow compressors. M. P. Boyce (Texas A & M University, College Station, Tex.), R. N. Schillier, and A. R. Desai. *American Society of*

Mechanical Engineers, Gas Turbine Conference and Products Show, Zurich, Switzerland, Mar. 30-Apr. 4, 1974, Paper 74-GT-89. 7 p. Members, \$1.00; nonmembers, \$3.00.

The phenomenon of surge in an axial flow compressor has long eluded the analytical fluid dynamist. In the recent years, a growing degree of improvement and sophistication in the design of axial flow compressors to achieve higher pressure ratios has resulted in increasingly narrow domains of stable operation. A search for improving stability margins revealed the importance of the blade tip region and casing treatments. The authors have approached the problem by both experimental and analytical methods. The results are mutually confirming. Important new inroads have been made in understanding the flow in the blade tip region, operation of casing treatments, and the mechanism of the onset of surge. (Author)

A74-27474 # Theoretical solution of high subsonic flow past two-dimensional cascades of airfoils. C. Lakomy (Ceskomoravska Kolben Danek, Prague, Czechoslovakia). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Zurich, Switzerland, Mar. 30-Apr. 4, 1974, Paper 74-GT-91*. 6 p. 9 refs. Members, \$1.00; nonmembers, \$3.00.

The paper presents an entirely novel theoretical solution of inviscid flow past two-dimensional cascades of aerofoils at high subsonic velocities. The solution is carried out in the physical plane by the help of transformation equations derived for streamline coordinates. The transformation equations define the dependence between the flow fields in the regions of incompressible and compressible flows past the cascade. Knowing the incompressible flow, one can calculate the velocity distribution on an aerofoil and the outlet flow angle of the cascade in a comparatively simple way. The method makes it possible to determine the critical Mach number of the cascade with ease. The requisite computer time is relatively short. (Author)

A74-27480 # Objectives for a course in aircraft gas turbines. O. Lancaster (Pennsylvania State University, University Park, Pa.). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Zurich, Switzerland, Mar. 30-Apr. 4, 1974, Paper 74-GT-98*. 13 p. Members, \$1.00; nonmembers, \$3.00.

Education is similar to other endeavors in that for effective achievement there must be goals. Hence, teachers should explicitly formulate learning objectives in every course they teach. Teachers usually list only the subject matter. This should be supplemented by precise statements as to what the students are to learn. The statements should be operational. They should be expressed in action words which prescribe what the student is to do, how, and under what conditions he will demonstrate that he can do it. The establishment of objectives is illustrated by developing them for a course in aircraft gas turbines. (Author)

A74-27484 # The use of desk top computers in the teaching of aircraft gas turbines. G. C. Oates (Washington, University, Seattle, Wash.). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Zurich, Switzerland, Mar. 30-Apr. 4, 1974, Paper 74-GT-115*. 11 p. Members, \$1.00; nonmembers, \$3.00.

The fairly recent advent of programmable desk top computers with branching and looping capability has allowed the simple and rapid handling of otherwise very complicated engineering problems. The teaching of aircraft gas turbines is particularly enhanced by the use of such computers because remarkably accurate performance calculations, design calculations, or flow field calculations can be made on such machines. The rapid calculation capability of the computer frees the student to concern himself with the implications of the results, rather than with the minutia of the calculations. Four specific example programs and results are given. (Author)

A74-27486 # Integrated propulsion systems for V/STOL transports. J. M. Zabinsky and R. N. Carter (Boeing Commercial

Airplane Co., Seattle, Wash.). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Zurich, Switzerland, Mar. 30-Apr. 4, 1974, Paper 74-GT-118*. 11 p. 8 refs. Members, \$1.00; nonmembers, \$3.00.

The integration of the propulsion system into the design of a vertical/short takeoff and landing (V/STOL) commercial transport for 1985 is presented. On a V/STOL airplane it provides the force for lift and cruise, is the sole source of energy for control, and is powerful enough to handle emergencies including those within the propulsion system itself. The propulsion system concepts all have moderate pressure ratio fans. Some are remotely driven and can be interconnected for power transfer, others have integral fans. The problems of propulsion integration and the conflicting aspects of the various concepts are shown. The considerations of commercial operation lead to limits on noise generation and establish a cruise requirement of Mach 0.75. The aircraft size, weight, and cost are the factors by which the designs are compared. (Author)

A74-27494 # Theory of rotor dynamics with coupling of disk and blade flexibility and support structure asymmetry. N. Klompas (General Electric Co., Gas Turbine Products Div., Schenectady, N.Y.). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Zurich, Switzerland, Mar. 30-Apr. 4, 1974, Paper 74-GT-159*. 7 p. Members, \$1.00; nonmembers, \$3.00.

The classical theory of shaft whirling is extended to account for three dimensional effects, due to asymmetry of support structures and flexibility of disks and blades, often encountered in modern aircraft engines. The shaft assumes a component of whipping in addition to steady whirling; the resulting elliptical motion alters the gyroscopic effect of the classical theory and introduces the possibility of coupled disk and blade vibration. A sample analysis of a model of a representative engine rotor illustrates possible drastic inadequacy of the classical theory. (Author)

A74-27501 Quality exponent method for planning and interpretation of results of full-scale, low-cycle fatigue tests. E. Schaap (Israel Aircraft Industries, Ltd., Lod Airport, Israel). *Society of Automotive Engineers, Automotive Engineering Congress, Detroit, Mich., Feb. 25-Mar. 1, 1974, Paper 740218*. 11 p. 7 refs. Members, \$1.25; nonmembers, \$2.00.

A74-27510 Adhesively bonded laminated metal structure. R. J. Stout (General Dynamics Corp., Convair Aerospace Div., San Diego, Calif.). *Society of Automotive Engineers, Automotive Engineering Congress, Detroit, Mich., Feb. 25-Mar. 1, 1974, Paper 740259*. 10 p. 5 refs. Members, \$1.25; nonmembers, \$2.00. Contract No. F33615-73-C-3001.

The fail-safe advantages of laminated structure can be applied to various types of structures such as spars, ribs, bulkheads, and wing skins. Potential application to a large area structure is discussed. One of the preliminary designs studied involved the use of adhesively bonded metal laminates for the lower box plate of a wing carry-through structure. The major problems that could be encountered in this application are flatness of the 0.12-in. thick titanium sheet, air entrapment and subsequent void formation in the extremely large area bond, nondestructive inspection of a ten-ply metal laminate, and hole drilling and bolt performance in a multi-ply metal laminate. Adhesives data that must be made available include adhesive properties such as shear modulus, large area bond effects, overlap length/metal thickness effects, and VQ/I shear properties. F.R.L.

A74-27511 * Consolidated presentation of fatigue data for design applications. R. C. Rice and C. E. Jaske (Battelle Columbus Laboratories, Columbus, Ohio). *Society of Automotive Engineers, Automotive Engineering Congress, Detroit, Mich., Feb. 25-Mar. 1, 1974, Paper 740277*. 20 p. 45 refs. Members, \$1.25; nonmembers, \$2.00. Contract No. NAS1-11344.

A74-27520 # Alpha Jet - A German-French joint venture. S. Haller (Bundesamt für Wehrtechnik und Beschaffung, Koblenz, West Germany). *Dornier-Post* (English Edition), no. 1, 1974, p. 24-28.

The original Dornier Do P 375 project was concerned with the development of a two-seat, twin-jet trainer in response to the German Air Force's need for a jet aircraft for elementary and advanced training during the years from 1976 to 1980. Similar requirements on the part of the French Air Force led to the Alpha Jet TA 501 project undertaken jointly by the Federal Republic of Germany and France. Aspects of the concept phase of the project are discussed together with the definition phase, the execution of the program, and details regarding the bilateral government organization involved. G.R.

A74-27529 # Statistical properties of vertical shear of lateral velocity. P. Kumar. *Journal of Applied Meteorology*, vol. 13, Mar. 1974, p. 237-241. 6 refs. Research sponsored by the National Research Council.

The statistical properties of two-point differences, Delta v prime, along the vertical of the lateral component of turbulence (horizontal component perpendicular to mean wind vector) in the first 150 m of the unstable atmospheric boundary layer are analyzed with experimental data. The results of the analysis show that Delta v prime is distributed according to the Pearson Type IV distribution. The standard deviation of Delta v prime is proportional to 0.11 power of the absolute value of (z sub 2 - z sub 1)/z sub 1, where z sub 2 and z sub 1 are elevations above natural grade of the points of concern. The skewness appears to be independent of z sub 1 and z sub 2, and the kurtosis is a monotonically decreasing function of (z sub 2 - z sub 1)/z sub 1. The analysis also shows no systematic dependence of the above-noted moments on the Monin-Obukhov stability parameter. (Author)

A74-27591 Anglo-French collaboration - Concorde and supersonic transport /26th Louis Bleriot Lecture/. R. Chevalier (Société Nationale Industrielle Aérospatiale, Paris, France). *Aeronautical Journal*, vol. 78, Feb.-Mar. 1974, p. 61-64.

The current status of development of Concorde is examined, giving attention to range, economy, and ecology. The range of the Concorde depends on the holding reserves required. It is argued that a supersonic aircraft should get priority at the destination because of the express service provided by it. In this case the range of the aircraft would be sufficient for the flight from Paris to New York. Other methods of improving the range of Concorde are also considered. Surveys conducted show that a Concorde service would be profitable to the airlines because the percentage of passengers willing to pay the higher fare for the express service is substantially higher than the percentage paying for the accommodations of the first class of the 747. G.R.

A74-27611 # Complete mechanical energy utilization in aeronautical propulsion systems (O iskorishchenju mekhanichke energije vazdukhoplovnikh pogonskikh grupa). S. Pivko. *Srpska Akademija Nauka i Umetnosti, Glas, Odeljenje Tehnickikh Nauka*, no. 10, 1973, p. 91-108. In Serbian.

Energy losses during useful power production in reciprocating piston engines and turbojet engines are discussed. Mechanical friction, propeller blade drag and slipstream turbulence and rotation are considered as the causes of energy losses in the former. Mechanical friction, incomplete kinetic-to-pressure energy conversion, air compression in the compressor, incomplete fuel burning, gas flow turbulence, acceleration and drag, combustion product expansion, and incomplete gas-to-kinetic energy conversion in the nozzle are considered as the causes of energy losses in the latter. V.Z.

A74-27634 HS.146 progress report. A. Hofton. *Flight International*, vol. 105, Apr. 11, 1974, p. 457-462.

Because many operators will use the HS.146 for stages with

flight times of about one-half hour, particular attention has been paid to minimizing those costs which are related to the number of flight cycles rather than to flying hours. A target figure for direct maintenance costs has been established and techniques are being employed to monitor and control these costs throughout the design to the same extent as, for example, weight and manufacturing costs. Lycoming reports that test-rig and flight tests have shown that the ALF 502 fan engine has a high tolerance of inlet distortion, and during accelerations with accessory loads the engine is surge-free. The ALF 502 is built up from four basic modules that can be handled and serviced separately, and are interchangeable between engines.

F.R.L.

A74-27674 What do aircraft reliability statistics prove. L. Kahn (Boeing Co., Seattle, Wash.). *Interavia*, vol. 29, Apr. 1974, p. 325, 326.

There appears to be a significant variance between conclusions drawn from the available airline statistics with regard to the relative merits and performance of wide-body commercial transports. The reasons for the discrepancies are explored. Analyses of the mechanical schedule reliability data of similar models operated by different airlines seem to emphasize the important effect of route structure. Other variables, such as training and operating procedures, can account for the proficiency spread between operators flying over similar routes.

G.R.

A74-27773 # Forecast of jet engine exhaust emissions for future high altitude commercial aircraft. J. Grobman and R. D. Ingebo (NASA, Lewis Research Center, Cleveland, Ohio). *U.S. Department of Transportation, Conference on Climatic Impact Assessment, 3rd, Cambridge, Mass., Feb. 26-Mar. 1, 1974, Paper. 32* p. 35 refs.

Projected minimum levels of engine exhaust emissions that may be practicably achievable for future commercial aircraft operating at high altitude cruise conditions are presented. The forecasts are based on: (1) current knowledge of emission characteristics of combustors and augmentors; (2) the current status of combustion research in emission reduction technology; and (3) predictable trends in combustion systems and operating conditions as required for projected engine designs that are candidates for advanced subsonic or supersonic commercial aircraft. Results are presented for cruise conditions in terms of an emission index, g pollutant/kg fuel. Two sets of engine exhaust emission predictions are presented: the first, based on an independent NASA study and the second, based on the consensus of an ad hoc committee composed of industry, university, and government representatives. The consensus forecasts are in general agreement with the NASA forecasts.

(Author)

A74-27776 Frankfurt's scheduled traffic mathematically analyzed. *Airport Forum*, vol. 4, Mar. 1974, p. 9-16. In English and German.

As in many other fields, an increasing application of the mathematical approach is also discernible in the transport area. Complex processes are reproduced in suitable mathematical models and run through the computer. An analysis is made of the distribution of takeoffs and landings at Frankfurt Rhein-Main Airport on a peak day in 1973, as a contribution to the analysis of the operating loads of busy major airports with parallel runway systems.

(Author)

A74-27807 # Acquisition signal design for satellite-aircraft communications. R. M. Gagliardi (Southern California, University, Los Angeles, Calif.). *American Institute of Aeronautics and Astronautics, Communications Satellite Systems Conference, 5th, Los Angeles, Calif., Apr. 22-24, 1974, Paper 74-437*. 6 p. Members, \$1.50; nonmembers, \$2.00.

A study is made of the interference effects when rapid acquisition techniques are used in a multiple-access environment. The

prime object is to determine the manner in which the actual acquisition waveform structure effects the overall system performance. When interference variance is used as a criterion, it is shown that rapid acquisition waveforms made up of component waveforms having disjoint, flat, wideband spectra produce minimal interference. The result suggests the use of coded-tone acquisition waveforms. The results have application to ranging, surveillance, or navigation operations performed between transmitter-receiver pairs. (Author)

A74-27809 # CONUS aeronautical radionavigation by satellite. I. G. Stiglitz (MIT, Lexington, Mass.). *American Institute of Aeronautics and Astronautics, Communications Satellite Systems Conference, 5th, Los Angeles, Calif., Apr. 22-24, 1974, Paper 74-439*. 7 p. 17 refs. Members, \$1.50; nonmembers, \$2.00. Research supported by the U.S. Department of Transportation.

Over the past half decade a variety of satellite system concepts have been promulgated as solutions to the CONUS ATC problems. By categorizing these, it is possible to draw some generally valid observations about the characteristics of each of these. By selecting system architectures representative of each category, key technical aspects of systems within each category can be explored. Critical aspects illuminated include: avionics complexity, required number of satellites, system vulnerability, capacity, required ground processing, and accuracy.

(Author)

A74-27811 # Access control techniques for satellite mobile communications systems. J. J. Bisaga and H. A. Blank (Computer Sciences Corp., Falls Church, Va.). *American Institute of Aeronautics and Astronautics, Communications Satellite Systems Conference, 5th, Los Angeles, Calif., Apr. 22-24, 1974, Paper 74-441*. 12 p. Members, \$1.50; nonmembers, \$2.00. U.S. Department of Transportation Contract No. TSC-565.

Results of a study conducted to develop techniques of communication/surveillance traffic management for aircraft-satellite systems. Specifically, system configurations, complete with access control subsystems, have been conceived, analyzed, compared to one another, and conclusions reached as to performance capabilities. These configurations were developed for the contemplated AERO-SAT Atlantic Oceanic ATC System. Five basic system configurations are reported along with a like number of other systems representing variations of the basic configurations. These configurations have been developed with respect to satellite coverage estimates, system communication capacity, and multiple access, modulation, and demand access control methodologies.

(Author)

A74-27844 # Some aspects of airfoil stall in low-speed flow. H. C. Kao (Northrop Corp., Hawthorne, Calif.). *Journal of Aircraft*, vol. 11, Mar. 1974, p. 177-180. 8 refs.

In the process of reviewing some existing data on low-speed airfoil stalling, it was found that it is possible to correlate the pressure distributions in the long bubbles of thin-airfoil stalling by using the reduced coordinates originally intended for the separation of base flow. The correlation so obtained bears close resemblance to the one for base flow. An existing correlation curve of leading-edge reattachment is used with measurements on NACA 0010 and NACA 66(sub three)-018 airfoils to indicate the possibility of predicting the allowable angle of attack for maximum lift of moderately thick airfoils.

(Author)

A74-27846 # On calculation of induced drag and conditions downstream of a lifting wing. W. R. Sears (Cornell University, Ithaca, N.Y.). *Journal of Aircraft*, vol. 11, Mar. 1974, p. 191, 192.

Consideration of certain subtleties connected with the calculation of the induced drag of a wing in terms of conditions far behind it. These subtleties cast light on some interesting facts concerning the flow downstream of a lifting wing system and arise from the fact that, for a lightly loaded wing, the drag is a second-order quantity. Considering specifically a wing of elliptic lift distribution, it is shown

that the induced angle far downstream cancels out of the calculation and that the net pressure contribution is a force directed upstream.

A.B.K.

A74-27848 **YF-17 evolved from previous data base.** D. E. Fink. *Aviation Week and Space Technology*, vol. 100, Apr. 15, 1974, p. 46, 47, 49-51.

Northrop's YF-17 twin-engine twin-tail lightweight fighter, designed for high maneuverability on the basis of advanced aerodynamic techniques developed by the company to meet basic air combat requirements, is examined. The design is based on experience obtained with the T-38 Talon trainer, the F-5 fighter and trainer series, and the P-530 Cobra fighter. The principal design characteristics of the craft developed with emphasis on climb, acceleration, and turning rate in the Mach 0.9 to 1.5 range are discussed and illustrated.

V.P.

A74-27849 **Stratospheric survey aircraft developed.** *Aviation Week and Space Technology*, vol. 100, Apr. 15, 1974, p. 62, 63, 65.

A remotely piloted small-scale aircraft under development, intended to fly stratospheric survey missions with a ceiling of up to 100,000 ft, is examined. Termed the Mini-Sniffer, the canard aircraft will have a maximum gross takeoff weight of 145 lb and a payload of 25 lb. The two-stroke hydrazine monopropellant reciprocating engine (driving a variable-diameter propeller) is mounted in the aft pusher position to eliminate interference with the nose-mounted air sampling probes. The main wing is a high-aspect-ratio design with a span of 18 ft, an area of 35.5 sq ft, and a sweep angle of 20 degrees.

V.P.

A74-27884 # **Automation of measurements and of data processing for experiments in an IL-18 aircraft laboratory (K voprosu avtomatizatsii izmerenii i obrabotki rezul'tatov eksperimentov samoleta-laboratorii IL-18).** A. A. Buznikov and N. A. Poliakova. In: *Radiation studies in the atmosphere.* Leningrad, Gidrometeoizdat, 1973, p. 124-133. 16 refs. In Russian.

Considerations are given for automation of the recording equipment in an airborne laboratory carried by an IL-18 aircraft for meteorological and earth resources studies under a recently initiated program of energy conversion studies in the earth-atmosphere interface. It is suggested that the currently used analog signal recording system be changed to a discrete signal recording system. It is also indicated that the present data acquisition and processing system should be computerized for automatic operation.

V.Z.

A74-27894 # **Reflection-measuring aircraft instruments. II - Spectral albedometer (Samoletnye pribory dlia izmereniia otazheniia. II - Spektral'nyi al'bedometr).** V. I. Korzov and L. B. Krasil'shchikov. In: *Radiation studies in the atmosphere.* Leningrad, Gidrometeoizdat, 1973, p. 200-204. 8 refs.

In Russian.

The optical scheme and principles of operation of a spectral albedometer in which the incoming and outgoing radiation pass successively through the same filters to a common receiver are discussed. In combination with a spectral device for measuring the relative luminance indicatrix, the albedometer will measure the spectral reflection coefficients, when mounted at the wing tip of the aircraft.

V.P.

A74-27898 # **The problem of increasing the operational precision of electrolytic sensors (K voprosu povysheniia tochnosti raboty elektroliticheskikh datchikov).** Ia. E. Shcherbakov, N. A. Zatravkin, and K. M. Konstantinovich (Moskovskii Institut Inzhenerov Geodezii, Aerofotos'emki i Kartografii, Moscow, USSR). *Geodeziia i Aerofotos'emka*, no. 6, 1973, p. 113-117. In Russian.

Electrolytic sensors used for measuring the angle of inclination exhibit a dead zone near the horizontal position and show poor

accuracy at small angles of inclination as a consequence. This drawback is eliminated in a proposed differential bridge circuit which provides a difference reading of signals from two sensors mounted on a common base. The sensors form identical nonzero angles with the horizontal plane when the base is at zero inclination, and the difference signal for this initial position is equal to zero.

T.M.

A74-27899 # **Protection of an optical sensor against vibration of the flight vehicle (Zashchita opticheskogo datchika ot vibratsii letatel'nogo apparata).** A. L. Lysenkov and V. A. Perov. *Geodeziia i Aerofotos'emka*, no. 6, 1973, p. 119-125. 6 refs. In Russian.

Aircraft structural vibrations give rise to an error component in the output of an optical sensor that generates a frequency-modulated electric signal (with frequency proportional to the ratio of flight velocity to flight altitude) for automatic flight-axis control of exposure in aerial photography. The present work describes theoretical and experimental studies of vibration-damping sensor mounting designed to minimize the effect of random aircraft vibration. Recommendations include design guidelines for sensor mountings, differential-bridge circuit wiring of photosensors to eliminate low-frequency components in the signal spectrum, spatial filtering to eliminate high-frequency components, and the use of electrical bandstop filters tuned to the frequency of mechanical-vibration components.

T.M.

A74-28050 # **Inverse transonic flow calculations using experimental pressure distributions.** L. A. Carlson (Texas A & M University, College Station, Tex.). *AIAA Journal*, vol. 12, Apr. 1974, p. 571, 572.

A finite-difference procedure is used for the determination of the nonlinear small-perturbation potential in a transonic flow about an airfoil by direct or mixed direct-inverse calculations. It is demonstrated that the inverse transonic flowfield calculations using the perturbation potential as the independent variable are consistent with direct calculations, and that the inverse transonic calculations by this method are useful in describing the effects of viscous-inviscid interactions involved.

V.Z.

A74-28075 # **Automated piloting of heavy aircraft (Avtomatizirovannoe vozhdzenie tiazhelykh samoletov).** V. N. Vasilinin. Moscow, Voenizdat, 1973. 200 p. 30 refs. In Russian.

The principles of design of piloting-navigational complexes and the fundamentals of a method of piloting an entire class of modern heavy aircraft are outlined in a generalized manner. Following a review of basic concepts, a detailed account is given of the structure of piloting-navigational complexes used in subsonic and supersonic heavy aircraft, and generalized criteria for evaluating such complexes are proposed. The role of the central navigational computer in processing data received by sensors of primary parameters is discussed. A brief description is given of ordinary navigation charts used for piloting heavy aircraft, and the principles of operation of integral indicators are outlined in accordance with the classification adopted for piloting-navigational complexes. A procedure is developed for carrying out a standard high-altitude automated flight, and the measures required in the preparation of the crew and the piloting-navigational complex for long automated flight are discussed.

A.B.K.

A74-28169 * # **Application of unsteady lifting surface theory to propellers in forward flight.** C. E. Hammond, H. L. Runyan, and J. P. Mason (NASA, Langley Research Center, Hampton, Va.). *AIAA, ASME, and SAE, Structures, Structural Dynamics and Materials Conference, 15th, Las Vegas, Nev., Apr. 17-19, 1974, AIAA Paper 74-419*. 11 p. 10 refs. Members, \$1.50; nonmembers, \$2.00.

Development of a theory for determining the aerodynamic forces for unsteady, compressible subsonic flow on a propeller in

forward flight. The acceleration potential method is used in developing the basic downwash integral equation which governs the flow. This integral equation is solved by the doublet-lattice method, which consists of placing 'load' lines at certain locations on the chord and satisfying the downwash condition at other selected positions. The examples presented include the spanwise and chordwise loading on a rotating propeller for incompressible flow, an example of compressible flow calculations, and, finally, a calculation illustrating the loss of aerodynamic damping of a propeller blade due to the passage of the blade over its own wake. (Author)

A74-28173 * # Optimal aeroelastic design of an oblique wing structure. L. B. Gwin (NASA, Ames Research Center, Moffett Field, Calif.). *AIAA, ASME, and SAE, Structures, Structural Dynamics and Materials Conference, 15th, Las Vegas, Nev., Apr. 17-19, 1974, AIAA Paper 74-349*. 7 p. 9 refs. Members, \$1.50; nonmembers, \$2.00. Research supported by the National Research Council and NASA.

A procedure is presented for determining the optimal cover panel thickness of a wing structure to meet specified strength and static aeroelastic divergence requirements for minimum weight. Efficient reanalysis techniques using discrete structural and aerodynamic methods are used in conjunction with redesign algorithms driven by optimality criteria. The optimality conditions for the divergence constraint are established, and expressions are obtained for derivatives of the dynamic pressure at divergence with respect to design variables. The procedure is applied to an oblique wing aircraft where strength and stiffness are critical design considerations for sizing the cover thickness of the wing structure. (Author)

A74-28283 * Instrumentation for airbreathing propulsion; Proceedings of the Symposium, U.S. Naval Postgraduate School, Monterey, Calif., September 19-21, 1972. Symposium sponsored by the U.S. Air Force, U.S. Navy, U.S. Army, and NASA. Edited by A. E. Fuhs (U.S. Naval Postgraduate School, Monterey, Calif.) and M. Kingery (ARO, Inc., Arnold Engineering Development Center, Arnold Air Force Station, Tenn.). Cambridge, Mass., MIT Press (Progress in Astronautics and Aeronautics, Volume 34), 1974. 547 p. \$20.

New developments and refinements in measuring techniques used for both ground testing and in-flight control, diagnosis, and monitoring of airbreathing combustors are analyzed in a number of papers. Some of the techniques studied include the application of laser velocimeters for flow measurements; on-the-shaft data systems for rotating engine components; total pressure averaging in pulsating flows; fiber optic and laser digital pressure transducers; holography of nozzles, jets, and spraying systems; application of the Raman effect to flowfield diagnostics; holography of JP-4 droplets and combusting boron particles; the use of a laser-powered optical proximity probe in advanced turbofan engine development; pyrometry for measurement of surface temperature distribution on a rotating turbine blade; an ultrasonic turbine inlet gas temperature sensor; automatic detection and suppression of inlet buzz; and electrostatic probes for sensing incipient engine failure.

P.T.H.

A74-28285 * Research instrumentation requirements for flight/wind-tunnel tests of the YF-12 propulsion system and related flight experience. W. G. Schweikhard and E. J. Montoya (NASA, Flight Research Center, Edwards, Calif.). In: *Instrumentation for airbreathing propulsion; Proceedings of the Symposium, Monterey, Calif., September 19-21, 1972*. Cambridge, Mass., MIT Press, 1974, p. 19-39. 12 refs.

Description of the requirements for a comprehensive flight and wind-tunnel propulsion research program to examine the predictability of inlet performance, evaluate the effects of high-frequency pressure phenomena on inlets, and investigate improved control

concepts in order to cope with airframe interactions. This program is unique in that it requires precise similarity of the geometry of the flight vehicle and tunnel modes; the test conditions, including local flow at the inlet; and instrumentation. Although few wind-tunnel instrumentation problems exist, many problems emerge during flight tests because of the thermal environment. Mach 3 flight temperatures create unique problems with transducers, connectors, and wires. All must be capable of withstanding continuous 1000 F temperatures, as well as the mechanical stresses imposed by vibration and thermal cycling. (Author)

A74-28286 * Instrumentation for in-flight determination of steady-state and dynamic inlet performance in supersonic aircraft. R. H. Smith and F. W. Burcham, Jr. (NASA, Flight Research Center, Edwards, Calif.). In: *Instrumentation for airbreathing propulsion; Proceedings of the Symposium, Monterey, Calif., September 19-21, 1972*. Cambridge, Mass., MIT Press, 1974, p. 41-58. 9 refs.

A74-28287 System for evaluation of F-15 inlet dynamic distortion. A. P. Farr and G. A. Schumacher (McDonnell Aircraft Co., St. Louis, Mo.). In: *Instrumentation for airbreathing propulsion; Proceedings of the Symposium, Monterey, Calif., September 19-21, 1972*. Cambridge, Mass., MIT Press, 1974, p. 59-75; Discussion, p. 75, 76.

An instrumentation and data acquisition system for evaluating inlet dynamic distortion has been developed for use in the F-15 full-scale wind-tunnel and flight-test programs. The system consists of the following: high- and low-frequency-response pressure transducers mounted in an inlet rake, data acquisition systems for both high- and low-response measurements, and an analog computer for economical evaluation of dynamic distortion data. The rake incorporates 48 low-response and 48 high-response total-pressure probes, arranged in an eight-leg, six-ring, configuration. The transducers for the low-response probes are located in a temperature-controlled compartment within the engine nose dome. The high-response transducers are located on the rake legs, adjacent to the low response probes. After filtering, separate data acquisition systems record the low- and the high-response data. The combined total pressure signal, made up of the low- and high-response signals, has a nearly flat response from 0 to 1000 Hz. (Author)

A74-28296 * Modularized instrument system for turbojet engine test facilities. W. C. Nieberding and D. R. Englund, Jr. (NASA, Lewis Research Center, Cleveland, Ohio). In: *Instrumentation for airbreathing propulsion; Proceedings of the Symposium, Monterey, Calif., September 19-21, 1972*. Cambridge, Mass., MIT Press, 1974, p. 205-215.

A new modular instrument system is being developed to handle the many channels of data commonly encountered in turbojet engine testing. Each module contains a group of transducers and all the signal conditioning, multiplexing, and digitizing electronics necessary for direct interface with a digital computer. The digital interface within each module is the same for all modules. Each module provides a controlled environment for its contents. A minicomputer in the control room gathers the data, performs some on-line calculation and display, and interfaces with a shared recording and computing system. The advantages of this system are (1) reduced manpower for system installation, setup, and checkout; (2) standardized equipment interfaces; (3) increased reliability through automatic system testing and through minimization of manual adjustments; and (4) reduced cost through minimization of wiring and simplification of control room display. (Author)

A74-28298 Current state-of-the-art for airbreathing combustor measurements. W. M. Shaffernocker (General Electric Co., Aircraft Engine Group, Evendale, Ohio). In: *Instrumentation for*

airbreathing propulsion; Proceedings of the Symposium, Monterey, Calif., September 19-21, 1972. Cambridge, Mass., MIT Press, 1974, p. 227-246; Discussion, p. 246, 247. 8 refs.

Combustor exhaust gas temperature is the most important measurement in assessing the combustion efficiency of advanced aircraft engines and determining exhaust profile. This measurement is accomplished principally by the use of either thermocouple or gas analysis. Embedded and flame spray thermocouple attachments have been developed for measurement of structure temperature. Measurement of combustion instability was the first major use of unsteady pressure measurements in engine testing. Piezoelectric transducers mounted on a nonresonant probe tube have been used but are now being replaced with miniature semiconductor transducers which are much less subject to trouble from dirt, moisture, and particularly the vibration and high noise environment of an engine test. (Author)

A74-28303 Use of laser-powered optical proximity probe in advanced turbofan engine development. H. D. Hardy (United Aircraft Corp., Pratt and Whitney Aircraft Div., West Palm Beach, Fla.). In: Instrumentation for airbreathing propulsion; Proceedings of the Symposium, Monterey, Calif., September 19-21, 1972. Cambridge, Mass., MIT Press, 1974, p. 317-323.

A laser-powered optical proximity probe was developed for measurement of the clearances between rotating and stationary components in gas-turbine engines. The determination and precise control of these clearances during all aspects of aircraft engine operation are essential not only for safe operation but to ensure optimum performance. Test results utilizing the optical probe reveal the complex nature of the expansion and contraction of typical turbine components during engine transient operation. The probe, consisting of a laser light source, optical fibers, and hard optics plus a TV monitor, has measured consistently clearance variations from 0 to 0.100 in. with accuracies of 0.002 in. at turbine airflow operating temperatures above 2400 F. Possible utilization of the laser probe encompasses flight test applications and in-service engine conditioning monitoring. (Author)

A74-28309 Turbine blade pyrometer system in the control of the Concorde engine. K. R. Curwen (Kollsman Instrument, Ltd., Southampton, England). In: Instrumentation for airbreathing propulsion; Proceedings of the Symposium, Monterey, Calif., September 19-21, 1972. Cambridge, Mass., MIT Press, 1974, p. 399-407.

The salient features of the pyrometer system for the Concorde's Olympus engine are described. Duplex channels are provided for each engine; these feed the two lanes of the engine control system. The temperature signal is used to limit the engine fuel flow so that excessive blade temperatures are avoided. By the use of pyrometry, the necessity of deducing blade temperature from exhaust-gas thermocouple measurements is eliminated, enabling the engine to be uprated. The average engine thrust and efficiency are thereby increased, which is especially significant for a supersonic transport. (Author)

A74-28311 Engine sensory requirements for energy management. I. A. Carnegis (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). In: Instrumentation for airbreathing propulsion; Proceedings of the Symposium, Monterey, Calif., September 19-21, 1972. Cambridge, Mass., MIT Press, 1974, p. 419-436.

Advanced high-performance military fighter and bomber systems must use an advanced technique of energy management. Energy management in terms of optimum throttle and flight path will yield significant improvements in fuel, time, and distance over conventionally operated aircraft. Nominal flight path performance for certain mission segments is compared to fixed throttle optimum flight path performance and to variable throttle optimum flight path performance. Mission throttle control parameters are identified that can be measured in the engine and on the airframe during flight.

These parameters are used to serve as indicators of the optimum throttle position. This avoids the necessity of carrying extensive throttle position data on board the aircraft. Sensors and transducers that may be used in the flight control/engine throttle control system are discussed. (Author)

A74-28313 Automatic detection and suppression of inlet buzz. L. O. Billig (Boeing Co., Seattle, Wash.). In: Instrumentation for airbreathing propulsion; Proceedings of the Symposium, Monterey, Calif., September 19-21, 1972. Cambridge, Mass., MIT Press, 1974, p. 453-460.

The buzz detector/suppressor, which was developed for the SST, operated on the same pressure ratio signal used for bypass control when the inlet was not started. The signal was filtered, rectified, and integrated so that an output signal was generated when flow disturbances of buzz frequency were encountered. This output signal was summed with the control signal to drive the inlet bypass doors open and stabilize the flow. The signal decayed when the flow stabilized so that normal control was then resumed. Results of wind-tunnel tests run on a 1/6 scale model under closed-loop control are given. In these tests, buzz was suppressed, typically, in 0.4 sec after unstart. In other tests with the suppressor, flow was stabilized at 3 deg inlet angle of incidence while, without it, the inlet buzzed until the tunnel was shut down. (Author)

A74-28314 Engine condition monitoring as a part of the propulsion management concept. R. K. Sibley (United Aircraft Corp., Pratt and Whitney Aircraft Div., East Hartford, Conn.). In: Instrumentation for airbreathing propulsion; Proceedings of the Symposium, Monterey, Calif., September 19-21, 1972. Cambridge, Mass., MIT Press, 1974, p. 463-470.

Optimum use of airbreathing engines may be achieved by monitoring significant engine parameters in flight and using a data analyzing system which provides engine diagnostics based on these parameters. There have been recent significant accomplishments of propulsion monitoring equipment in terms of flight-worthy reliability and accuracy. The equipment can be designed to accommodate aircraft weight and volume constraints and maintain the necessary credibility of the acquired data. By selectively acquiring in-flight data, the equipment will provide the user with only meaningful information regarding the operational condition of the engine. The concept of an in-flight condition monitoring system developed to maximize maintenance effectiveness and safety of flight is investigated. Instrumentation and hardware requirements, considering concept goals, weight, volume, and cost, are discussed. (Author)

A74-28315 Inflight engine condition monitoring system. G. C. Van Cleve (General Motors Corp., Detroit Diesel Allison Div., Indianapolis, Ind.). In: Instrumentation for airbreathing propulsion; Proceedings of the Symposium, Monterey, Calif., September 19-21, 1972. Cambridge, Mass., MIT Press, 1974, p. 471-479.

Description of a prototype in-flight engine condition monitoring system designed to monitor engine operation and automatically record data during selected flight modes, engine limit exceedances, and transient engine conditions. The recorded data are analyzed at the completion of a flight or at the end of the day by a computer program which outputs engine status and maintenance actions if required. In addition, the recorded data are suitable for 'trending' at some central computer location. (Author)

A74-28316 A systems engineering approach to effective engine condition monitoring. D. W. Leiby (General Electric Co., Aircraft Engine Group, Evendale, Ohio). In: Instrumentation for airbreathing propulsion; Proceedings of the Symposium, Monterey, Calif., September 19-21, 1972. Cambridge, Mass., MIT Press, 1974, p. 481-498.

The development and application of a variety of engine

condition monitoring techniques and equipment are being accelerated currently as a result of increasing demands for improved aircraft flight readiness availability, improved mission success probability, and reduced maintenance costs. Although individual monitoring methods provide valuable information, optimum effectiveness can be achieved only through their application and utilization in an engineered system of complementary techniques. To achieve effective condition monitoring, therefore, an integrated system of airborne and ground monitoring, diagnostic, and inspection techniques and equipment applied to aircraft turbine engines for purposes of problem detection, isolation, and trend monitoring is required. (Author)

A74-28318 Engine aids and the metrologist syndrome. H. M. Snowball (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). In: Instrumentation for airbreathing propulsion; Proceedings of the Symposium, Monterey, Calif., September 19-21, 1972. Cambridge, Mass., MIT Press, 1974, p. 505-514. 12 refs.

Exploration of the cost of ownership factors associated with engine condition monitoring systems (ECMS). Use of ECMS in commercial aviation already has shown great payoff in maintenance; greater payoff is anticipated for military aircraft in terms of mission completion, saved engines, and better maintenance scheduling. However, with increasing ability to make measurements and identify indicators of performance, there will be growth in ECMS cost, complexity, and maintenance. Means are recommended for avoiding the metrologist syndrome of over-instrumentation. (Author)

A74-28320 Engine condition monitor system to detect foreign object damage and crack development. H. R. Hegner (IIT Research Institute, Chicago, Ill.). In: Instrumentation for airbreathing propulsion; Proceedings of the Symposium, Monterey, Calif., September 19-21, 1972. Cambridge, Mass., MIT Press, 1974, p. 531-547.

The inspection of compressor rotor blades on an aircraft jet engine is generally a difficult and time-consuming problem. Test and analysis demonstrated that significant foreign object damage (FOD) resulted in one or more of the blade-tip parameters exceeding the specified tolerance limits by a large value. By suitable tip-parameter sensor design, important evidence of FOD or crack development can be monitored. An exploratory model system using tip-parameter sensors was developed for detecting tip curl, blade-tip twist, and blade-tip-to-blade-tip spacing which exceeds the normal engine tolerances of these quantities on an operating engine. Although this type of blade deformation is only a percentage of total FOD found on blades, a strong correlation appears to exist between this detectable damage and the total extent of FOD. (Author)

A74-28351 Two surprises for the Hanover exposition: Thrust gondola SG 85, Fanliner - Porsche of the air (Zwei Überraschungen für die Hannover-Schau: Schubgondel SG 85, Fanliner - Porsche der Luft). *Deutscher Aerokurier*, vol. 18, Apr. 1974, p. 226-228. In German.

The 'thrust gondola' is a thrust-providing device which can be mounted on a glider. The new device consists of a shrouded propeller, a Wankel engine, a sound attenuation system, and a covering structure which ensures adequate cooling. Powered gliders with low operational noise characteristics can be obtained by using the new device for the propulsion of gliders. A two-place sports aircraft, the RFB Fanliner, is currently being developed in cooperation between a German and an American aerospace firm. The Fanliner fuselage has about the same height as a Porsche automobile. The aircraft uses a shrouded propeller and a Wankel engine. The flight characteristics of the new aircraft are similar to those of a jet. G.R.

A74-28419 Some extensions of thin-shock-layer theory. L. C. Squire (Cambridge University, Cambridge, England). *Aeronautical*

Quarterly, vol. 25, Feb. 1974, p. 1-13. 18 refs.

In the usual form of thin-shock-layer theory, it is assumed that the flow about a lifting body can be expanded in terms of the inverse density ratio across a basic oblique shock wave lying in the plane of the leading edges of the body. In this paper, it is shown that more accurate results can be obtained by moving the basic shock closer to the calculated shock wave below the body. The results obtained show why the original form of thin-shock-layer theory often gave good agreement with experiment in conditions which appeared to be outside the range of validity of the theory. (Author)

A74-28420 Solution of the non-linear differential equations for finite bending of a thin-walled tube by parameter differentiation. T. Y. Na and C. E. Turski (Michigan, University, Dearborn, Mich.). *Aeronautical Quarterly*, vol. 25, Feb. 1974, p. 14-18. 7 refs.

A74-28421 Minimum induced drag of non-planar ground effect wings with small tip clearance. T. Kida and Y. Miyai (Osaka Prefecture, University, Osaka, Japan). *Aeronautical Quarterly*, vol. 25, Feb. 1974, p. 19-36. 11 refs. Research supported by the Matunaga Memorial Foundation.

This paper treats theoretically the problem of the minimum induced drag of nonplanar ground effect wings with both tips very close to the ground, within the limitations of the linearized lifting-line theory. The gap clearance between the wing tip and the ground is assumed to be very small and, using this small parameter, an approximate theory, which yields the minimum induced drag of a nonplanar ground effect wing, is formulated by the method of matched asymptotic expansions. As a check on the accuracy of the method, this theory is compared with the exact theory for a semicircular wing. This shows that the present method is accurate within the small gap clearance. (Author)

A74-28423 A simple integral method for the calculation of thick axisymmetric turbulent boundary layers. V. C. Patel (Iowa, University, Iowa City, Iowa). *Aeronautical Quarterly*, vol. 25, Feb. 1974, p. 47-58. 21 refs. Contract No. N00014-68-A-0196-0002.

A simple integral method is described for the calculation of a thick axisymmetric turbulent boundary layer. It is shown that the development of the boundary layer can be predicted with acceptable accuracy by using an approximate form of the momentum-integral equation, an appropriate skin-friction law, and an entrainment equation obtained for axisymmetric boundary layers. The method also involves the explicit use of a velocity profile family in order to interrelate some of the integral parameters. Available experimental results have been used to demonstrate the general accuracy of the method. (Author)

A74-28432 # Black-box philosophy in reliability of aircraft structures. J. Drexler. *Zprava VZLU*, no. Z-20, 1974. 10 p. 20 refs.

The presented report deals with some problems encountered when establishing first life estimations of the theoretical design as well as when experimentally verifying the reliability of an airframe. A nontypical black-box approach is shown in deriving a non-stationary stochastic hypothesis of cumulative fatigue damage for the case where a two-dimensional random loading process is acting on the input of the structure under investigation. Results of the theoretical investigation were compared with experimental data gained from fatigue tests of a breaking undercarriage strut of the well-known jet-trainer L-29 Delphine. (Author)

A74-28433 # The use of magnetic recording in measurement systems for in-flight measurements (Použití magnetického záznamu v mericích retezích pro letová měření). K. Suchý. *Zpravodaj VZLU*, no. 6, 1973, p. 7-21. 24 refs. In Czech.

Consideration of the requirements imposed on the onboard and ground portions of measurement systems for in-flight measurements. A brief description is given of an analog recording-reproduction system which includes a measuring tape recorder. It is shown that the requirements of developed aircraft tests can be satisfied only by the use of a combination of series PCM recording, FM multiplex, and recording by a method of wideband frequency modulation in a hybrid magnetic system supplemented by telemetric transmission. The information flow in the numerical part of the system is determined, and its structure is indicated. A brief analysis is made of possible methods of processing series PCM signals from in-flight measurements. A.B.K.

A74-28434 # Current state of development of lubricating oils for aircraft turbine engines (Soucasny stav vyvoje mazacich oleju letackych turbinovych motoru). J. Krotky. *Zpravodaj VZLU*, no. 6, 1973, p. 23-27. 12 refs. In Czech.

Consideration of the problems connected with ensuring the quality of lubricating oils for gas turbine engines for subsonic and supersonic aircraft. After noting the conditions under which such lubricants must operate and the failure of lubricants manufactured out of petroleum to meet all the requirements, the development of new types of synthetic lubricants is discussed, in particular, two types of ester-base lubricants. The possibility of developing lubricants suitable for supersonic transport aircraft is also considered, since the ester-base lubricants are suitable only for short-duration supersonic flights. A.B.K.

A74-28435 # New developments in aircraft instrumentation (Novinky v pristrojovem vybaveni). J. Heissiger. *Zpravodaj VZLU*, no. 6, 1973, p. 29-36. In Czech.

Review of the current trends of development of onboard aircraft instrumentation, including examples of new flight instruments, instrument systems, and instruments for monitoring power plants. The instruments discussed include a two-pointer speedometer, a combination speedometer and machmeter, a two-pointer altimeter, a servomechanical altimeter, an rpm meter, a jet gas temperature meter, and a combination indicator of various power plant parameters. A.B.K.

A74-28436 # A review of aircraft measurement techniques (Hlidka letacke merici techniky). J. Tuma. *Zpravodaj VZLU*, no. 6, 1973, p. 37-40. In Czech.

Description of the parameters of a number of recently developed instruments and systems used in aircraft measurement technology. The basic properties of digital voltmeters are reviewed, as well as the factors governing the choice of a particular voltmeter. A detailed description is then given of the operation of Schlumberger 'Master Series' digital voltmeters. Also discussed are some secondary pressure standards and systems for onboard tensometric and thermocouple measurements produced by this firm. Finally, some new types of calculators produced by Hewlett-Packard for scientific and technical calculations are described. A.B.K.

A74-28457 Experimental investigations of strongly swept turbine cascades with low speed flow. J. M. Hill and R. I. Lewis (Newcastle-upon-Tyne, University, Newcastle-upon-Tyne, England). *Journal of Mechanical Engineering Science*, vol. 16, Feb. 1974, p. 32-40. 10 refs.

Results are presented from an investigation into the blade to blade and meridional flow perturbations arising in high deflection turbine cascades subjected to large sweep angles. Experimental work has confirmed previous analytical estimates of the effect of sweep and indicated that certain common design procedures for the calculation of blade to blade flows are seriously in error. The significance of the results with reference to practical design considerations is discussed. (Author)

A74-28487 # The present technics of air transportation (La técnica actual del transporte aéreo). R. Fernandez. *Ingeniería Aeronáutica y Astronáutica*, vol. 25, Nov.-Dec. 1973, p. 11-25. In Spanish.

The historical background of air transportation is examined, giving attention to development after World War I, the consolidation of the airlines after 1930, the introduction of jets, and the employment of computers and other electronic equipment. The present situation regarding air transportation is considered, taking into account the introduction of wide-body airliners and the prospects of supersonic airliners. Aspects of technology examined are related to transonic aerodynamics, questions of longitudinal stability, propulsion systems, and techniques used to obtain a long operational life for aircraft. The presently available types of airliners are discussed together with questions of future developments, the reduction of aircraft noise and air pollution, aspects of maintenance, and problems in connection with the needed expansion of air-transportation services. G.R.

A74-28526 # Geometrical study of the conditions of initiation of sudden cracks of quasi-brittle type (Geometricka studie podmínek vzniku náhlých lomů kvazikřehkého typu). J. Drexler. *Zpravodaj VZLU*, no. 5, 1973, p. 7-13. In Czech.

Consideration of a random mechanism which determines when fracture at a critical point in a structure with a complex cross-sectional geometry will be of sudden quasi-brittle, plastic, or mixed type. The range of validity of the mechanism is given by boundary conditions with regard to the loading process and the technology of the examined structure, which are also of random nature. On the basis of fracture-mechanics concepts, the critical limits of the direction angles of the front of a secondary plastic flow are determined for this mechanism as a function of the geometrical parameters of the cross section and the size of the initial defect - a fatigue crack which arose in the neighborhood of the critical cross section. A.B.K.

A74-28528 # Development and problems of testing prepreps for the Czechoslovakian aircraft industry (Vyvoj a problematika zkouseni prepregu pro ucely cs. letackeho prumyslu). J. Kobes and Z. Lachman. *Zpravodaj VZLU*, no. 5, 1973, p. 19-31. 15 refs. In Czech.

Review of the fabrication and processing of prepreg type materials and of their applications in the aircraft industry. The basic problems in the development of a flexible epoxy prepreg are described, and the main physicochemical properties of the developed prepreg are given and are compared with similar types of prepreps made outside of Czechoslovakia. Problems in testing the binder content of a prepreg, the degree of conversion of the binder, the flexibility and plasticity of a prepreg at normal temperatures, the cohesiveness of a prepreg, its adhesion to metals, and its storability are discussed. A.B.K.

STAR ENTRIES

N74-19637 Southern Methodist Univ., Dallas, Tex.
THE SEPARATING TURBULENT BOUNDARY LAYER: AN EXPERIMENTAL STUDY OF AN AIRFOIL TYPE FLOW Ph.D. Thesis

James Hassler Strickland, Jr. 1973 237 p
 Avail: Univ. Microfilms Order No. 74-5178

Experimental measurements in a separating turbulent boundary layer were made. Mean velocity and turbulence intensity profiles were obtained using hot film and laser anemometry. Mean and fluctuating wall shear stress distributions were obtained using flush mounted hot film sensors. The bursting frequency at various streamwise locations was also obtained from the wall hot film sensors. The intermittency was obtained utilizing a photo-electric technique. The celerities of various eddy structures were obtained by using a double hot film probe. It was found that the bursting frequency could be obtained from the wall shear stress spectra based on comparison of spectra, short time autocorrelations, and Rao's correlation.

Dissert. Abstr.

N74-19638 Virginia Univ., Charlottesville.
DOWNWASH-VELOCITY POTENTIAL METHOD FOR OSCILLATING SURFACES USING AERODYNAMIC ELEMENTS IN SUBSONIC AND SUPERSONIC FLOWS Ph.D. Thesis

Young Sik Yoo 1973 185 p
 Avail: Univ. Microfilms Order No. 73-32465

Steady and unsteady aerodynamic loads are used in many types of structural and aeroelastic analyses of aircraft, such as flutter, gust and frequency response analyses. The application of the downwash-velocity potential method to the case of oscillating surfaces in subsonic and supersonic flows is developed. Calculated unsteady aerodynamic forces are given on rectangular wings, swept wings with or without control surfaces and T-tail configurations in subsonic flows. For supersonic flows steady aerodynamic forces are calculated on rectangular wings of various aspect ratios. The subsonic results are compared with other results published in the literature for reduced frequencies up to nine tenths, and for Mach numbers up to nine tenths. In supersonic flows steady aerodynamic coefficients are compared for Mach numbers ranging 1.2 to 1.8. Generally the results are shown to be in satisfactory agreement with other published results, for both subsonic and supersonic speeds. The concept of aerodynamic elements is presented, the computed results representing four possible types of rectangular elements.

Dissert. Abstr.

N74-19639 Oklahoma Univ., Norman.
A LIFTING LINE ANALYSIS OF NONPLANAR WINGS Ph.D. Thesis

William A. Edgington 1973 138 p
 Avail: Univ. Microfilms Order No. 74-4008

An equation relating the spanwise circulation distribution to the induced velocity at a given spanwise station for a nonplanar wing is developed using lifting line theory. The equation has as its unknowns the Fourier coefficients used to describe the circulation distribution. A system of non-homogeneous simultaneous equations results and is solved by the method of collocation. The proximity of a collocation point very near the wing tip is studied for wings having a semi-elliptical shape. As a result the downwash distributions very near the wing tip are in error and the arc length distance from the wing tip for the first collocation point must be restricted as to not affect the overall circulation

distribution. The validity of lifting line theory for the special case of a semi-circular shape is investigated by using lifting surface theory and allowing the ratio of the chord to circle radius to become very small. The results compare to those developed using lifting line theory.

Dissert. Abstr.

N74-19640* National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
INPUT DESCRIPTION FOR JAMESON'S THREE-DIMENSIONAL TRANSONIC AIRFOIL ANALYSIS PROGRAM

Perry A. Newman and Ruby M. Davis 7 Feb. 1974 27 p refs
 (NASA-TM-X-71919) Avail: NTIS HC \$4.50 CSCL 01A

The input parameters are presented for a computer program which performs calculations for inviscid isentropic transonic flow over three dimensional airfoils with straight leading edges. The free stream Mach number is restricted only by the isentropic assumption. Weak shock waves are automatically located where they occur in the flow. The finite difference form of the full equation for the velocity potential is solved by the method of relaxation, after the flow exterior to the airfoil is mapped to the upper half plane.

Author

N74-19641* Scientific Translation Service, Santa Barbara, Calif.

DIRECT CALCULATION OF AIRFOILS FROM PRESSURE DISTRIBUTION

R. Eppler Washington NASA Mar. 1974 64 p refs Transl. into ENGLISH from Ing.-Arch. (Berlin), v. 25, no. 1, 1957 p 32-57

(Contract NASw-2483)

(NASA-TT-F-15417) Avail: NTIS HC \$6.25 CSCL 01A

A method for determining airfoil profiles from the pressure or velocity distribution is described. The numerical factors make it possible to specify the profile thickness and to calculate the entire profile series by superposition. A minor disadvantage in the method is discussed and the procedure for correcting the discrepancy is analyzed. Mathematical models of the method are developed. The data for various types of airfoils are presented in graph form.

Author

N74-19643* General Dynamics/Fort Worth, Tex. Convair Aerospace Div.

AN EXPERIMENTAL INVESTIGATION OF LEADING-EDGE VORTEX AUGMENTATION BY BLOWING

R. G. Bradley, W. O. Wray, and C. W. Smith 1 Apr. 1974 93 p refs

(Contract NAS1-12682)

(NASA-CR-132415) Avail: NTIS HC \$7.75 CSCL 20D

A wind tunnel test was conducted to determine the effects of over-the-wing blowing as a means of augmenting the leading-edge vortex flow of several pointed-tip, sharp-edged planforms. Arrow, delta, and diamond wings with leading-edge sweeps of 30 and 45 degrees were mounted on a body-of-revolution fuselage and tested in a low-speed wind tunnel at a Mach number of 0.2. Nozzle location data, pitch data, and flow-visualization pictures were obtained for a range of blowing rates. Results show pronounced increases in vortex lift due to the blowing.

Author

N74-19646* Douglas Aircraft Co., Inc., Long Beach, Calif.
A THEORETICAL METHOD FOR CALCULATING THE AERODYNAMIC CHARACTERISTICS OF ARBITRARY JET-FLAPPED WINGS. VOLUME 1: THE ELEMENTARY VORTEX DISTRIBUTION JET-WING LIFTING SURFACE THEORY Final Technical Report

Michael L. Lopez, C. -C. Shen, and Norman F. Wasson May 1973 149 p refs

(Contract N00014-71-C-0250; NR Proj. 214-189)

(AD-773939; MDC-J5519-Vol-1) Avail: NTIS CSCL 01/1

The report describes a lifting surface theory for calculating the aerodynamic characteristics of jet-flapped wings. Based on

a finite-element scheme the method of Elementary Vortex Distribution or the EVD method, the wing and jet sheet are represented by a set of overlapped elementary vortex distributions. A solution is obtained by satisfying a set of mixed-type boundary conditions on both the wing and jet sheet. The EVD method, as described, provides the following: spanwise and chordwise loading; spanwise variation of induced drag; a capability to investigate the effects of part span flaps, part span blowing, rolling, yawing, pitching, and sideslip; and total lift and induced drag (momentum method), pitching moment, yawing and rolling moments, and side force. (Modified author abstract) GRA

N74-19649 Case Western Reserve Univ., Cleveland, Ohio.
STUDIES IN TILT-ROTOR VTOL AIRCRAFT AEROELASTICITY Ph.D. Thesis

Raymond George Kvaternik 1973 671 p
Avail: Univ. Microfilms Order No. 74-2538

The results of some aeroelastic and dynamic studies which complement and extend various aspects of technology applicable to tilt-rotor VTOL aircraft are presented. Particular attention is given to propotor/pylon whirl instability, a precession-type instability akin to propeller/nacelle whirl flutter. The blade flapping and pitch-change freedoms of a propotor are shown to lead to a fundamentally different situation as regards the manner in which the precession-generated aerodynamic forces and moments act on the pylon and induce whirl flutter relative to that of a propeller. The implication of these forces and moments with regard to their capacity for instigating a whirl instability is examined, demonstrating, apparently for the first time, precisely why a propotor can exhibit whirl flutter in either the backward or forward directions in contrast to a propeller which is found to always whirl in the backward direction. Dissert. Abstr.

N74-19651* Massachusetts Inst. of Tech., Cambridge. Flight Transportation Lab.
AIRCRAFT REQUIREMENTS FOR LOW/MEDIUM DENSITY MARKETS

R. Ausrotas, S. Dodge, H. Faulkner, I. Glendinning, A. Hays, R. Simpson, W. Swan, N. Taneja, and J. Vittek Sep. 1973 207 p refs
(Contract NASw-2412)
(NASA-CR-137373; FTL-R73-4) Avail: NTIS HC \$13.50 CSCL 01C

A study was conducted to determine the demand for and the economic factors involved in air transportation in a low and medium density market. The subjects investigated are as follows: (1) industry and market structure, (2) aircraft analysis, (3) economic analysis, (4) field surveys, and (5) computer network analysis. Graphs are included to show the economic requirements and the aircraft performance characteristics. Author

N74-19652# Advisory Group for Aerospace Research and Development, Paris (France).

DESIGN AGAINST FATIGUE

Dec. 1973 122 p refs Presented at the 37th Meeting of the Structures and Mater. Panel at the Hague, Netherlands, 7-12 Oct. 1973

(AGARD-CP-141) Avail: NTIS HC \$9.25

Papers presented at the conference on designing aircraft against fatigue are reported. Fatigue analysis and tests for fighter aircraft are emphasized.

N74-19653 British Aircraft Corp., Preston (England).
SOME CONSIDERATIONS OF THE INFLUENCE OF FATIGUE IN THE DESIGN OF STRIKE AIRCRAFT

A. N. Rhodes /In AGARD Design Against Fatigue Dec. 1973 17 p

After summarizing some of the factors which characterize strike aircraft with regard to their fatigue design, the types of external loading to which it will be subjected in service are considered. A consideration is also given to some of the factors which influence the choice of materials, aircraft layout and

design. Qualification of the finished product is discussed, as are some of the techniques in monitoring service usage. Problem areas are highlighted. Author

N74-19654 Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (West Germany).

FATIGUE DESIGN PRACTICE

K. Ahrensdoerf /In AGARD Design Against Fatigue Dec. 1973 18 p refs

To define missions for fatigue analysis, mission breakdown and to estimate load spectra for combat or tactical aircraft a high degree of guesstimating is necessary. Available data as to operational mission and load spectra during aircraft development differ greatly, on the other hand these estimated data have a considerable influence on aircraft design. For this reason the aircraft design shall be in such a way that inspections in critical regions are possible and crack propagation is noncritical between inspection intervals. In addition, on all flying aircraft cg - acceleration measurements are necessary, besides the results of full scale fatigue tests, to have available the complete information for individual life control of flying aircraft. Some aspects of the whole fatigue integrity program are discussed. Author

N74-19655 McDonnell Aircraft Co., St. Louis, Mo.

STRUCTURAL FATIGUE ANALYSIS AND TESTING FOR FIGHTER AIRCRAFT

L. F. Impellizzeri /In AGARD Design Against Fatigue Dec. 1973 12 p refs (2)

The design of fatigue resistant structure includes a combination of fatigue testing analysis. A review of the structural design and development programs of the F-4 and F-15 aircraft highlights their spectrum fatigue testing and indicates that these tests are essential in providing a satisfactory level of structural integrity. An existing procedure is discussed which utilizes Neuber's rule and a cyclicly decaying residual stress function to continually track notch root stress-strain patterns. The technique was developed particularly to predict life for fatigue spectra with either a constant minimum stress or a constant mean stress. A modification of the technique is presented which simplifies its applicability for fatigue spectra with variable minimum and/or mean stresses. This also includes variable stress ratios. Life predictions using the modified technique are compared with spectrum test results on 7075-T6 aluminum and 6Al-4V titanium. An example is presented of crack initiation and crack growth caused by out-of-plane bending in a fighter airplane upper wing skin. The local structural detail is analyzed. Fatigue analysis in terms of crack propagation is performed based on the residual tension predicted by the elastic-plastic computer program as the crack extends. Calculated crack growth rates are compared with electron microscope photographs of the upper wing skin fracture surface showing striation spacings. Author

N74-19656 Grumman Aerospace Corp., Bethpage, N.Y.

FATIGUE AND FRACTURE CONSIDERATIONS FOR TACTICAL AIRCRAFT

I. G. Hedrick, L. B. Wehle, and P. D. Bell /In AGARD Design Against Fatigue (date) 15 p refs

A review of some of the practical aspects of designing against fatigue is presented. An outline is included of the latest fatigue analysis method used at Grumman and a discussion of some of the more interesting fatigue problems encountered in the evolution of several Grumman aircraft. Some new technological developments are discussed, including the F-14 electron beam welded titanium wing carry-through box. The capabilities of some special Grumman inspection techniques to improve quality are reviewed. Author

N74-19657 Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (West Germany).

FULL SCALE FATIGUE REQUIREMENTS FOR RATIONAL FATIGUE LIFE PREDICTION

H. J. Zocher /In AGARD Design Against Fatigue Dec. 1973 14 p refs

After discussing a suitable fatigue life evaluation and certification procedure, some requirements are specified for full scale fatigue testing techniques which should be mandatory for future fatigue life substantiation. Test results obtained from two full scale fatigue tests utilizing different testing procedures are compared to service failures. The fatigue test which used the proposed improved testing technique with flight-by-flight loading sequence showed much better results which were in adequate correlation with service experience. Author

N74-19658 Royal Aircraft Establishment, Farnborough (England). Structures Dept.

THE ROLE OF THE MAJOR FATIGUE TEST IN THE ACCEPTANCE, CERTIFICATION AND SAFE UTILISATION OF STRIKE AIRCRAFT

R. D. J. Maxwell *In* AGARD Design Against Fatigue Dec. 1973 8 p refs

The role of the major fatigue test in acceptance, certification, and safe utilization of a strike aircraft is examined from the writing of the aircraft specification to the monitoring of life consumption in service. Attention is focussed on problems associated with defining the test load conditions and interpreting the results in terms of the monitoring system used, including the use of relevant flight load measurements. A summary of the problem areas and suggested minimum standards of fatigue testing, flight measurement and dissemination of the information are included. Author

N74-19659 National Aero- and Astronautical Research Inst., Amsterdam (Netherlands).

RE-ASSESSMENT OF FATIGUE PERFORMANCE OF FIGHTER AIRCRAFT

G. M. VanDijk *In* AGARD Design Against Fatigue Dec. 1974 19 p refs

Fatigue monitoring results obtained by means of strain-gauge recordings are scrupulously compared to the reference full-scale fatigue test loading, finally yielding a relative fatigue severity index. The comparative analysis among other things highlights the importance of ground loads, counting methods and local plasticity at notch roots. A complex notch stress-strain history analysis is carried out to assess the notch root stress history and residual stresses. Finally, a simplified calculation procedure is suggested to account for notch root plasticity and residual stresses. This simplified analysis is a sufficiently accurate substitute of the complex notch stress-strain history analysis. Author

N74-19660 Societe Nationale Industrielle Aerospatiale, Paris (France).

DESIGNERS' NEED FOR GENERAL INFORMATION FROM ANALYSIS OF FATIGUE TEST RESULTS AND SERVICE BEHAVIOR

William Barrois *In* AGARD Design Against Fatigue Dec. 1973 13 p refs

The requirements in fatigue assessment for designing aircraft structures are discussed in terms of interpretative computation, a priori subjective classification of fatigue strength, and prediction analysis. The analyses of fatigue behavior in tests and in service, and the standardization of test loading are discussed along with interpretation methods of fatigue test results, and the establishment of general data on fatigue strength. F.O.S.

N74-19661* Scientific Translation Service, Santa Barbara, Calif.

TUPOLEV 144 AND CONCORDE: THE OFFICIAL PERFORMANCE ARE COMPARED FOR THE FIRST TIME

Jacques Morisset. Washington NASA Apr. 1974 10 p Transl. into ENGLISH from Air et Cosmos (France), v. 11, no. 494, 8 Sep. 1973 p 22-23, 48 (Contract NASw-2483)

(NASA-TT-F-15446) Avail: NTIS HC \$4.00 CSCL 01C

Preliminary Soviet data and accurate French-English flight data are used to compare the performances of the Concorde and the TU-144 in the following areas: flight profiles, takeoff weight, range, payload capability, takeoff and landing distances. Author

N74-19662* National Aeronautical Establishment, Ottawa (Ontario).

ESTIMATES OF THE LATERAL-DIRECTIONAL STABILITY DERIVATIVES OF A HELICOPTER FROM FLIGHT MEASUREMENTS

D. G. Gould and W. S. Hindson. Dec. 1973 69 p refs (NRC-13882; LR-572; ISSN-0077-5541) Avail: NTIS HC \$6.50

The lateral-directional stability derivatives for a medium-sized single rotor helicopter were estimated for three different forward speeds. The analysis technique is based on a least squares quasilinearization method which employs a specially formatted parameter vector so that reliable a priori estimates can be used to assist convergence. An additional unique feature is the procedure adopted to reduce the influence of unknown atmospheric inputs on the parameter estimates by means of a conglomerate analysis of several similar runs. Author

N74-19663* National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

WIND TUNNEL INVESTIGATION OF A LARGE-SCALE SEMISPAN MODEL WITH AN UNSWEPT WING AND AN UPPER-SURFACE BLOWN JET FLAT

Charles C. Smith, Jr., Arthur E. Phelps, III, and W. Latham Copeland. Washington Feb. 1974 146 p refs Prepared in cooperation with Army Air Mobility R and D Lab., Hampton, Va. (NASA-TN-D-7526; L-9137) Avail: NTIS HC \$4.75 CSCL 01C

An investigation of the static longitudinal aerodynamic characteristics of a large-scale semispan model with an unswept wing and an upper-surface blown jet flap for lift augmentation was conducted in the Langley full-scale tunnel. The wing had an aspect ratio of 7.8 (3.9 for the semispan) and a simulated turbofan engine mounted ahead of and above the wing in a nacelle with a rectangular-exit nozzle. The flap system had three spanwise flap segments: (1) an inboard plain flap located behind the engine and having a large radius of curvature to provide a smooth upper surface to enhance the turning of the jet sheet, (2) a double-slotted midspan flap, and (3) a drooped aileron equipped with blowing boundary-layer control. The wing was also equipped with a full-span leading-edge Krueger flap with blowing boundary-layer control. In addition to the aerodynamic measurements, noise measurements were also included in the investigation for positions above and below the wing. Author

N74-19665* National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

WIND TUNNEL TESTS OF A FULL-SCALE MODEL OF A LIGHT TWIN-ENGINE AIRPLANE WITH FIXED AUXILIARY AIRFOIL OR LEADING-EDGE SLOT

Marvin P. Fink, James P. Shivers, and Lucy C. White. Washington Apr. 1974 119 p refs

(NASA-TN-D-7474; L-9225) Avail: NTIS HC \$4.50 CSCL 01C

An investigation has been conducted by means of wind-tunnel tests of a full-scale mockup of a light twin-engine airplane configuration to determine the effects of outboard partial-span slots and of auxiliary airfoils ahead of the leading edge of the wing in improving aerodynamic characteristics at high angles of attack. Both of the stall-control devices gave considerable improvement in high angle-of-attack characteristics with the auxiliary airfoil giving the more favorable results, but neither device performed as well as might have been expected. Author

N74-19666* Techtran Corp., Silver Spring, Md.

CIVIL AVIATION IN THE USSR (THE FIFTIETH ANNIVERSARY OF ITS FORMATION)

A. F. Aksenov. Washington NASA Apr. 1974 52 p ref Transl. into ENGLISH of the Russian book Moscow, Znaniye Press, 1973

(Contract NASw-2485)

(NASA-TT-F-806) Avail: NTIS HC \$3.75 CSCL 01B

The history of the development of Soviet civil aviation has paralleled the burgeoning of Soviet power and influence in the

20th century. The influence of aircraft on transportation and national unity is naturally emphasized, while such valuable contributions as the transport of the sick by air, construction of buildings using helicopters, and the aerial surveying and extermination of insect pests are discussed as well. Many types of Soviet aircraft are described and compared as to size, range and other characteristics. Author

N74-19667* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

SERVICE EVALUATION OF AIRCRAFT COMPOSITE STRUCTURAL COMPONENTS

William A. Brooks, Jr. and Marvin B. Dow Oct. 1973 22 p refs Presented at the 5th Natl. SAMPE Tech. Conf., Kiamasha Lake, N. Y., 9-11 Oct. 1973 (NASA-TM-X-71944; L-9024) Avail: NTIS HC \$4.25 CSCL 10C

The advantages of the use of composite materials in structural applications have been identified in numerous engineering studies. Technology development programs are underway to correct known deficiencies and to provide needed improvements. However, in the final analysis, flight service programs are necessary to develop broader acceptance of, and confidence in, any new class of materials such as composites. Such flight programs, initiated by NASA Langley Research Center, are reviewed. These programs which include the selectively reinforced metal and the all-composite concepts applied to both secondary and primary aircraft structural components, are described and current status is indicated. Author

N74-19668* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

PRELIMINARY MEASUREMENT OF THE AIRFRAME NOISE FROM AN F-106B DELTA WING AIRCRAFT AT LOW FLYOVER SPEEDS

Richard R. Burley Mar. 1974 42 p refs (NASA-TM-X-71527; E-7928) Avail: NTIS HC \$5.25 CSCL 01C

To establish a realistic lower limit for the noise level of advanced supersonic transport aircraft will require knowledge concerning the amount of noise generated by the airframe itself as it moves through the air. The airframe noise level of an F-106B aircraft was determined and was compared to that predicted from an existing empirical relationship. The data were obtained from flyover and static tests conducted to determine the background noise level of the F-106B aircraft. Preliminary results indicate that the spectrum associated with airframe noise was broadband and peaked at a frequency of about 570 hertz. An existing empirical method successfully predicted the frequency where the spectrum peaked. However, the predicted OASPL value of 105 db was considerably greater than the measured value of 83 db. Author

N74-19669* Techtran Corp., Glen Burnie, Md.

AIRCRAFT OF THE FUTURE

I. Tolztych Washington NASA Apr. 1974 10 p Transl. into ENGLISH from Tech. Oekonomische Inform. der Zivilen Luftfahrt, v. 8, no. 9, 1972 p 419-424 (Contract NASw-2485)

(NASA-TT-F-15424) Avail: NTIS HC \$4.00 CSCL 01C

Evaluation of the technical and economic efficiency of the types of aircraft likely to be developed in the coming decades involves discussion of the problem of evaluating the degree of structural maturity and perfection of passenger aircraft and their economic efficiency. Problems connected with the development of increasingly high-speed subsonic aircraft, supersonic, and, ultimately, hypersonic aircraft are discussed, including engine designs, fuels, and noise reduction. In addition, the use of V/STOLs to provide more efficient transportation between airports and city centers is considered. Author

N74-19671* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

A COMPILATION AND ANALYSIS OF TYPICAL APPROACH

AND LANDING DATA FOR A SIMULATOR STUDY OF AN EXTERNALLY BLOWN FLAP STOL AIRCRAFT

David B. Middleton and Hugh P. Bergeron Washington Apr. 1974 24 p refs (NASA-TN-D-7497; L-9142) Avail: NTIS HC \$3.00 CSCL 01C

A piloted simulation study has been made of typical landing approaches with an externally blown flap STOL aircraft to ascertain a realistic dispersion of parameter values at both the flare window and touchdown. The study was performed on a fixed-base simulator using standard cockpit instrumentation. Six levels of stability and control augmentation were tested during a total of 60 approaches (10 at each level). A detached supplement containing computer printouts of the flare-window and touchdown conditions for all 60 runs has been prepared. Author

N74-19672* National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

FLIGHT INVESTIGATION OF APPROACH AND FLARE FROM SIMULATED BREAKOUT ALTITUDE OF A SUBSONIC JET TRANSPORT AND COMPARISON WITH ANALYTICAL MODELS

Neil W. Matheny Washington Apr. 1974 36 p refs (NASA-TN-D-7645; H-803) Avail: NTIS HC \$3.25 CSCL 01C

Satisfactory and optimum flare windows are defined from pilot ratings and comments. Maximum flare normal accelerations, touchdown rates of sink, and total landing maneuver time increments are summarized as a function of approach airspeed margin (with respect to reference airspeed) and flare initiation altitude. The effects of two thrust management techniques are investigated. Comparisons are made with predictions from three analytical models and the results of a simulator study. The approach speed margin was found to have a greater influence on the flare initiation altitude than the absolute airspeed. The optimum airspeed was between the reference airspeed and the reference airspeed plus 10 knots. The optimum flare initiation altitude range for unrestricted landings was from 11 meters to 20 meters (36 feet to 66 feet), and the landing time in the optimum window was 8 seconds. The duration of the landing maneuver increased with increasing flare initiation altitude and with increasing speed margins on the approach. Author

N74-19675* PPG Industries, Inc., Creighton, Pa. Aircraft and Specialty Products.

DEVELOPMENT OF DESIGN, TEST, AND ACCEPTANCE CRITERIA FOR ARMY HELICOPTER TRANSPARENT ENCLOSURES Final Report

Leonard M. Cook, Glenn E. Freeman, Rudy L. Malobicky, and C. Robert Lang Sep. 1973 246 p refs (Contract DAAJ02-72-C-0073; DA Proj. 1F1-62205-A-119) (AD-772936; USAAMRDL-TR-73-65) Avail: NTIS CSCL 01/3

Because of the U.S. Army's growing concern for the high frequency of transparency replacement, a program to improve the overall reliability and maintainability of helicopter transparencies by appropriate development of design, test, and acceptance criteria was conducted. Analysis of all available specifications for windshields indicated that wiper abrasion resistance is seldom specified whereas heating requirements are always addressed. Military specifications for windshields and some other parts are lacking, and actual qualification tests for finished products are incomplete. The developed specification attempts to correct this inadequacy by proposing a complete document that is applicable for all transparencies on current and near-future rotary-wing aircraft. Bird impact tests of current and some potential windshield designs indicate that present glass-laminates and 1/4-inch stretched acrylic do not have a strike resistance beyond 100 mph, whereas the use of polycarbonate achieves a resistance at a speed of at least 200 mph. (Modified author abstract) GRA

N74-19676* Army Engineer Topographic Labs., Fort Belvoir, Va.

STUDIES OF THE ARMY AVIATION (V/STOL) ENVIRON-

MENT. REPORT NO. 9: CLASSIFICATION AND WORLD DISTRIBUTION OF VEGETATION RELATIVE TO V/STOL AIRCRAFT OPERATIONS Special Final Report

William C. Robison and John Viletto, Jr. Dec. 1973 35 p refs

(DA Proj. 1F1-62203-A-119)

(AD-773734; ETL-SR-74-4) Avail: NTIS CSCL 01/1

The ability of V/STOL aircraft to land on or take off from unprepared sites is greatly affected by the vegetation of a locality. Dense forests make normal landings impossible, but they can provide a cushion in the event of a crash landing. Sites with fewer trees may be used for landings and takeoffs but may offer hazards from deadfall, protruding trees, fire, or airborne litter. Other vegetation types involve few direct hazards to aviation but may conceal bodies of water, present seasonal fire hazards, or have specialized growth forms (such as cacti) that impede landings. Considered from the point of view of effects on the operation of V/STOL aircraft, vegetation can be classified into nine formation-classes: closed forest, open forest and woodland, savanna, treeless grassland, closed shrubs, sparse woodland and scrub, vegetation sparse to absent (without trees), aquatic vegetation, and cultivated vegetation with short planting cycles. (Modified author abstract) GRA

N74-19677# Cornell Univ., Ithaca, N.Y. RESEARCH ON HELICOPTER NOISE Final Report, 25 Jun. 1970 - 1 Oct. 1973

William R. Sears 1974 7 p refs

(Contract DAHC04-70-C-0057; DA Proj. DO1-61102-B-33G)

(AD-77385; AROD-9372-3-F) Avail: NTIS CSCL 01/1

The report summarizes research on helicopter noise under the following headings: Broadband noise; high-speed blade slap; and noise related to blade accelerations. GRA

N74-19678# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div. DETERMINATION OF THE FORCES IN THE KINEMATIC PAIRS OF A LANDING GEAR MECHANISM

I. M. Mitryaev 15 Jan. 1974 12 p. Transl. into ENGLISH from Tr. Prikl. Mekh. (USSR), no. 95, 1968 p 26-30

(AF Proj. 1369)

(AD-773877; FTD-HT-23-789-74) Avail: NTIS CSCL 01/3

The report examines the mechanical forces exerted on the linked members of a landing gear mechanism. GRA

N74-19679# Sacramento Air Materiel Area, McClellan AFB, Calif. Joint Technical Coordinating Group for Air Launched Non-Nuclear Ordnance. AIRCRAFT/STORES COMPATIBILITY SYMPOSIUM PROCEEDINGS, VOLUME 1

20 Sep. 1973 261 p refs Conf. held at Sacramento, Calif., 18-20 Sep. 1973

(AD-773813; JTCG/ALNNO-WP-12-2-Vol-1) Avail: NTIS CSCL 01/3

The report contains the proceedings of and technical papers presented at the Aircraft/Stores Compatibility Symposium, held at the Woodlake Inn, Sacramento, California on 18-20 September 1973. In addition, it contains several other technical papers prepared for the symposium but which were not presented. The purpose of the symposium was to bring together the technical expertise within Government and industry throughout the world to review and discuss compatibility developments and experiences. GRA

N74-19680# Sacramento Air Materiel Area, McClellan AFB, Calif. Joint Technical Coordinating Group for Air Launched Non-Nuclear Ordnance. AIRCRAFT/STORES COMPATIBILITY SYMPOSIUM PROCEEDINGS, VOLUME 3

20 Sep. 1973 325 p refs Conf. held at Sacramento, Calif., 18-20 Sep. 1973

(AD-773815; JTCG/ALNNO-WP-12-2-Vol-3) Avail: NTIS CSCL 01/3

Contents: A study of the SUU-51A/B dispenser munition's high speed saturation problem and proposed solutions; Separation prediction of small electronic sensors from aircraft; A parametric/sensitivity study of store separation; Conformal carriage separation program; On safe separation criteria for external stores and pilot escape capsules (III); Effects of aircraft maneuver and jettison of pylon with stores; A parametric method of aerodynamic flow field presentation; An estimate of the effect of MER structural dynamics on store separation; Harpoon/P-3 Orion separation program; Store installed drag measurement and test techniques for improved resolution; Flight demonstrated performance improvements with conformal weapons. GRA

N74-19681# Sacramento Air Materiel Area, McClellan AFB, Calif. Joint Technical Coordinating Group for Air Launched Non-Nuclear Ordnance. AIRCRAFT/STORES COMPATIBILITY SYMPOSIUM PROCEEDINGS, VOLUME 4

20 Sep. 1973 352 p refs Conf. held at Sacramento, Calif., 18-20 Sep. 1973

(AD-773816; JTCG/ALNNO-WP-12-2-Vol-4) Avail: NTIS CSCL 01/3

Contents: An inflight investigation of the influence of stability and control parameters on weapon delivery accuracy; External store effects on the stability of fighter and interceptor airplanes; Potential application of active flutter suppression to future fighter attack aircraft; Nondestructive environmental testing for improved reliability in advanced development programs; A new approach for rapid flutter clearance of aircraft with external stores; An investigation of factors affecting the accuracy of the captive trajectory wind tunnel technique; A computer aided technique for determining aircraft/stores electrical interface requirements; Image system solution for mutual aerodynamic interface; A history of AV-8A (Harrier) weapon compatibility trials; Thermal considerations of stores in captive flight; Wind tunnel heating test of aircraft stores. GRA

N74-19683# Boeing Aerospace Co., Seattle, Wash. Research and Engineering Div. INTEGRATED LIFE SUPPORT SYSTEM: DESIGN STUDY MEDIUM STOL TRANSPORT Final Technical Report, Oct. 1971 - Mar. 1973

Wolf J. Hebenstreit, Wayne A. Berge, Roland K. Moir, Milton S. Worley et al Jul. 1973 327 p refs

(Contract F33657-72-C-0312; AF Proj. 412A)

(AD-773589; D180-14203A 1; ASD-TR-73-29) Avail: NTIS CSCL 01/3

The report contains the summary of all requirements analyses, concept developments, trade study results and final design data developed for an integrated life support system for 2 medium STOL aircraft. The effort was directed towards integrating all requirements into a design which has specifically tailored towards the missions, operational environments and human demands present in the system. Requirements were identified and translated into multiple design concepts which were evaluated and screened for trade study analysis. From the trade study analysis a final configuration was selected and documented in appropriate specifications. Author (GRA)

N74-19684# Kaman Aircraft Corp., Bloomfield, Conn. INVESTIGATION OF ADVANCED STRUCTURAL CONCEPTS FOR FUSELAGE Final Report

Robert J. Mayerjak and William A. Smyth Oct. 1973 148 p refs

(Contract DAAJ02-72-C-0057; DA Proj. 1F1-62208-A-170)

(AD-773597; R-1164; USAAMRDL-TR-73-72) Avail: NTIS CSCL 01/3

Design concepts are presented and evaluated for the application of fiber reinforced composite materials to fuselage structures. The concepts are evaluated on the basis of cost-effectiveness and performance when specifically applied to the aft fuselage of the Army AH-1G helicopter. Comparisons to the existing metal structure show that several of the new concepts

provide significant advantages in initial acquisition cost, life-cycle cost, weight, safety, reliability, and maintainability.

Author (GRA)

N74-19686# United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft Div.

CH 54A DESIGN AND OPERATIONAL FLIGHT LOADS STUDY

A. L. Mongillo, Jr. and S. M. Johnson Nov. 1973 79 p refs (Contract DAAJ02-72-C-0060; DA Proj. 1F1-62204-AA-82) (AD-773551; SER-64370; USAAMRDL-TR-73-39) Avail: NTIS CSCL 01/3

An analytical and correlation study of predicted fatigue design data and operational flight loads data for crane-type helicopters was conducted to compare operational mission profiles with a design mission profile and to provide data for use in establishing structural design criteria for future Army helicopters. Flight loads and usage data for CH-54A helicopters operating in Southeast Asia were compared with CH-54A design data. The effects of gross weight and altitude on true airspeed were determined. Fatigue spectra were developed for six dynamic components, and fatigue lives were calculated for these components. These fatigue lives were compared with lives predicted during CH-54A design. Service histories for these components were reviewed, and it was found that none of the changes made in these components resulted from load conditions. Peak operational load parameters were compared with limit static design values. Recommendations were then developed to assist in establishing future crane helicopter fatigue design criteria.

Author (GRA)

N74-19687# Army Electronics Command, Fort Monmouth, N.J.

PREFLIGHT TEST SIMULATION OF SUPERIMPOSED INTEGRATED TRAJECTORY ERROR DISPLAYS

Chris Tsoubanos and Robert Covington Jan. 1974 63 p refs (AD-773823; ECOM-4184) Avail: NTIS CSCL 01/2

The report describes a man-machine simulation of an image display (TV video terrain image) enhanced by the superposition of symbology conveying quantitative information. A hierarchy of symbolic displays with increasing information content superimposed on a TV video terrain image is developed as an aid in approach and in precision hover. The most sophisticated configuration required ground position information. To obtain ground position information, a position sensor which utilized a ground beacon radio such as the Electronic Location Finder (ELF) was simulated. The position information was shown to be necessary to obtain hover precision of less than five feet. Aircraft stabilization equipment (ASE) was also found necessary.

Author (GRA)

N74-19688# Mississippi State Univ., State College. Dept. of Aerophysics and Aerospace Engineering.

RESEARCH IN THE AREA OF THE AERODYNAMICS OF ROTORS AND PROPELLERS Final Report

Charles B. Cliett, Joe F. Thompson, Zahir U. A. Warsi, and Donald W. Boatwright 31 Jan. 1974 39 p refs (Contract DAHCO4-68-C-0003) (AROD-T-3-23-E; AD-773617; EIRS-ASE-74-3) Avail: NTIS CSCL 01/1

In the report references are made to journal articles, papers, and technical reports where the results are reported. Major subject areas are: laminar boundary layers on rotating blades, unsteady boundary layers, turbulent boundary layers, numerical solution of Navier-Stokes equations for two-dimensional and three-dimensional applications, a new boyd-fitted coordinate system for numerical solution of Navier-Stokes equations, wake geometry of a hovering rotor, inflow and wake studies of a full-scale hovering rotor, the design of airfoils for low Reynolds numbering applications, rotary wing noise generation, and downwash and trailing vorticity behind high-lift wings. (Modified author abstract)

GRA

N74-19689# Human Engineering Labs., Aberdeen Proving Ground, Md.

A DESIGN STUDY TO STANDARDIZE COLLECTIVE-STICK

CONTROLS IN US ARMY HELICOPTERS: A HUMAN FACTORS ENGINEERING (HFE) EVALUATION

Harry R. Stowell and Clarence A. Fry Oct. 1973 82 p refs (AD-773688; HEL-TM-24-73) Avail: NTIS CSCL 01/3

The design study was conducted by HEL to standardize collective-stick controls in U.S. Army helicopters. The objective was to formulate a standard which will specify functions and arrangement of switches on collective-stick controls in Army helicopters. Two types of collective-stick controls were developed to meet requirements in all categories of helicopters designed for the U.S. Army. A human factors engineering (HFE) evaluation was done by HEL on functional hard mock-up models representing the general design configuration developed for standardization of collective-stick controls. Results of the HFE test indicate that the configurations developed for standardization is suitable for developing airworthy designs for flight test.

Author (GRA)

N74-19690# Douglas Aircraft Co., Inc., Long Beach, Calif. **THE POWER PROFILE - A NEW TYPE OF AIRFOIL Technical Report, Apr. 1972 - Nov. 1973**

A. M. O. Smith and J. A. Thelander Jan. 1974 88 p refs (Contract N00014-71-C-0250; NR Proj. 212-418) (AD-773655; MDC-J6236) Avail: NTIS CSCL 01/3

A new concept in airfoils, termed power profiles, having a blunt trailing edge shape with two wall jets near the trailing edge is presented. The replacement of streamlining with properly designed blowing is used to prevent flow separation and additionally offers potential applications as a powered high-lift system, propulsive system, or low inertia control device. Exploratory wind tunnel tests of a 22.5% thick, 24-inch chord model with several control shapes were conducted and summarized. With high blowing (power mode) lift coefficients in excess of 8.0 were obtained, and with a very small amount of blowing (boundary layer control mode) unseparated flow and low drag was achieved. In the latter case blowing can be accomplished by natural ram air pressure and might serve as a substitute for streamlining. Applications of this concept and areas for additional study are outlined.

Author (GRA)

N74-19691# Army Aviation Systems Command, St. Louis, Mo.

MAJOR ITEM SPECIAL STUDY (MISS), CH-47A ROTARY WING HEAD FWD Interim Report, Jan. 1964 - Jul. 1973 Jan. 1974 24 p

(AD-773718; USAAVSCOM-TR-73-32) Avail: NTIS CSCL 01/3

The report is designed to illustrate cost savings which would result from specific efforts in the areas of product improvement in quality and design. For the purpose of this study the cost savings produced in the area of product improvement are based on total elimination of a certain failure mode or modes. Appropriate modes are chosen because of their proportion of the total removals or their proportion in combination with other similar modes. These eliminated removals are then assumed to follow the distribution of the remaining removal modes. The actual cost savings are determined from the increase in the mean time to removal based on the new removal distributions.

GRA

N74-19712# Army Aviation Systems Command, St. Louis, Mo.

MAJOR ITEM SPECIAL STUDY (MISS), CH-47A ALTERNATING GENERATOR Interim Report, Jan. 1964 - Jul. 1973 Jan. 1974 24 p

(AD-773720; USAAVSCOM-TR-73-33) Avail: NTIS CSCL 01/3

The report is designed to illustrate cost savings which would result from specific efforts in the areas of product improvement in quality and design. For the purpose of this study the cost savings produced in the area of product improvement are based on total elimination of a certain failure mode or modes. Appropriate modes are chosen because of their proportion of the total removals or their proportion in combination with other similar modes. These eliminated removals are then assumed to follow the distribution of the remaining removal modes. The actual cost savings are determined from the increase in the mean time to removal based on the new removal distributions.

GRA

N74-19714# Tyco Labs., Inc., Waltham, Mass.

DEVELOPMENT AND TESTING OF A CADMIUM TELLURIDE HIGH TEMPERATURE (750 F) INFRARED FIRE DETECTOR

Final Report, 28 Feb. 1972 - 19 Sep. 1973

G. Entine, R. Farrell, F. Wilson, and F. Wald Nov. 1973 73 p refs

(Contracts F33615-72-C-1489; F33615-71-C-1084;

AF Proj. 3048)

(AD-773324; C-222; AFAPL-TR-73-104) Avail: NTIS CSCL 01/2

CdTe photodetectors capable of operating continuously at 750F were packaged for flight testing as an aircraft engine fire detector. The sensors at temperature could detect a photosignal of 50 microwatts per square centimeter with a signal-to-noise ratio of over 20:1 and an output impedance of 1000 ohms. The units consist of two CdTe sensors separately sealed in hermetic TO-8 headers which are mounted inside a larger hermetically sealed housing made of Inconel. The detectors meet MIL-Spec 810B including temperature cycling up to 750F, well above the capability of all the available semiconductor infrared detectors.

Author (GRA)

N74-19822# Army Electronics Command, Fort Monmouth, N.J.

HIGH FREQUENCY RADIO EMISSION AND RECEPTION BY FOREST TREES AND BY HELICOPTER USING HYBRID ELECTROMAGNETIC ANTENNA COUPLERS

Kurt Ikrath, William Kennebeck, and Kenneth J. Murphy Dec. 1973 78 p refs

(DA Proj. 110-61101-A-91A)

(AD-773909; ECOM-4173) Avail: NTIS CSCL 09/5

Measurements by helicopter of 5.750 MHz radiation patterns from closely-spaced hemac-coupled forest trees and from a 24-foot high marine whip antenna at the same forest site show that the directivities of high-frequency skywave radiation from the trees and from the whip are controlled by the local forest structure. By operating these closely-spaced trees as a phased twin-tree XMTR array, control over the elevation of the maximal radiation lobes is gained by the radio operator, while the local forest structure remains in control of the geographic azimuth angles of the radiation minima. Analogous to the exploitation of forest trees as antennas, the body of the helicopter was used as an antenna by means of a hemac wrapped around its tail section. (Modified author abstract) GRA

N74-19891# National Aerospace Lab., Tokyo (Japan).

DESIGN AND DEVELOPMENT OF THE GUST WIND TUNNEL AT THE NATIONAL AEROSPACE LABORATORY

Kenichi Hirose, Kiyomi Kitamura, Yoshitaka Murakami, and Shigemi Shindo Sep. 1973 30 p refs In JAPANESE; ENGLISH summary

(NAL-TR-335) Avail: NTIS HC \$4.50

A gust wind tunnel, of the single return type, for performing tests under normal atmospheric conditions is described. The wind tunnel is equipped with two interchangeable test sections with a 2 m square cross section; one section is normally closed while the other is a semi-closed section with gust generators. The latter section is used for simulated tests of aircraft gust response and gust load. A six component pyramid type balance and a data processing system are also contained in the wind tunnel. Gusts in the test section are generated by oscillatory cascade wings installed at the upstream part of the semi-closed section, and simulates one dimensional vertical gusts with various frequencies and amplitudes. The vertical component of the resulting air flow appeared to follow the desired command signal and was understood to be capable of satisfactorily simulating various gusts. For the normal closed section, the maximum capable speed was 67 m/sec, the turbulence factor was 1.02, and the velocity deviation within the cross section was suppressed to within $\pm 0.1\%$ of the mean velocity at that section. Author

N74-19894# Air Force Systems Command, Wright-Patterson AFB, Ohio, Foreign Technology Div.
SELECTION OF LANDING FIELDS

M. Finikov 30 Nov. 1973 11 p refs Transl. into ENGLISH from Grazhdanskaya Aviat. (USSR), no. 3, Mar. 1973 p 21

(AD-772051; FTD-HT-23-536-74) Avail: NTIS CSCL 01/5

There is special importance in the selection of sites of support airfields for the group disposition of aircraft and helicopters. Here it is necessary to calculate the optimum zone of location of the agricultural airfield. Taken as the optimum zone is the section of land area remote from the tillable fields at a distance proportional to their total areas. GRA

N74-19898# Environmental Protection Agency, Arlington, Va. Task Group 1

LEGAL AND INSTITUTIONAL ANALYSIS OF AIRCRAFT AND AIRPORT NOISE AND APPORTIONMENT OF AUTHORITY BETWEEN FEDERAL, STATE, AND LOCAL GOVERNMENTS Final Report

Elizabeth Cuadra 27 Jul. 1973 413 p refs

(PB-225149/4GA; EPA-NTID-73.2) Avail: NTIS HC \$8.25 CSCL 01E

Data pertinent to legal and institutional analysis of aircraft and airport noise and apportionment of authority between Federal, State, and local governments are presented. The report is an interpretation of such data by the task group chairperson responsible for this specific report. It does not necessarily reflect the official views of EPA and does not constitute a standard, specification, or regulation. Author (GRA)

N74-19902*# Michigan State Univ., East Lansing, Div. of Engineering Research.

RESEARCH ON FREE AND IMPINGING JETS FOR THE DEVELOPMENT OF STOL AIRCRAFT Final Report

John F. Foss and Stanley J. Kleis 21 Jan. 1974 39 p refs

(Grant NGR-23-004-068)

(NASA-CR-138031) Avail: NTIS HC \$5.00 CSCL 20D

The effect of the exit plane conditions on the initial region of an axisymmetric jet was systematically investigated. An essentially top-hat mean velocity profile and a homogeneous turbulence structure were maintained at the exit plane for eight distinct scale and intensity conditions. Mass and momentum flux values are independent of the exit turbulence structure for the range investigated; however, a significant (approximately 25%) increase in the latter implies a pronounced static pressure decrement inside the jet. Details of the velocity profile and turbulence structure are influenced by the exit plane conditions. The three radial-axial components of the Reynolds stress tensor have been conditionally sampled and are analyzed to show the initial condition effects. Author

N74-19904*# Scientific Translation Service, Santa Barbara, Calif.

STABILITY AND DECAY OF FREE VORTICES BEHIND A WING

H. Bippes Washington NASA Apr. 1974 10 p Transl. into ENGLISH from DEVLN-Nachrichten (West Germany), Oct. 1973 p 455-457

(Contract NASw-2483)

(NASA-TT-F-15445; A74-11805) Avail: NTIS HC \$4.00 CSCL 20D

An experimental investigation was conducted regarding the system of free vortices which detach themselves from a rectangular wing. During the tests the model was moved while the fluid medium remained at rest. This approach made it possible to observe the vortices for more than one minute until they finally decayed. The flow was made visible with the aid of hydrogen bubbles which were obtained by electrolysis of the medium water by means of a wire serving as cathode. Author

N74-20054# Civil Aeromedical Inst., Oklahoma City, Okla.

IN-FLIGHT PERFORMANCE OF CIVILIAN PILOTS USING MOVING-AIRCRAFT AND MOVING-HORIZON ATTITUDE INDICATORS

A. Howard Hasbrook Jun. 1973 21 p refs

(AD-773450; FAA-AM-73-9) Avail: NTIS CSCL 01/4

The in-flight performance of civilian instrument-rated pilots using two different types of attitude indicators in a general aviation aircraft was measured during typical instrument flying maneuvers. The instruments were an inside-out (moving-horizon) indicator and an outside-in (moving aircraft) indicator. The subjects were divided into low and high experience groups. The results of the study differ in some degree with those of some recent ground-based studies which used the same two concepts of attitude presentation. However, one result of the in-flight study agreed with many of the previous studies; low time pilots exhibited a narrower range of pitch excursions with the outside-in (moving aircraft) attitude indicator than they did with the inside-out (moving horizon) indicator. When combined with the authors' observations of a head-horizon tilt phenomenon relating to both humans and animals, the results of this study suggest the usefulness of a new concept for the design of the attitude indicator display. A new concept is described in the report. Author (GRA)

N74-20059# Honeywell, Inc., Minneapolis, Minn. Systems and Research Div.

AN INVESTIGATION OF AIRBORNE DISPLAYS AND CONTROLS FOR SEARCH AND RESCUE (SAR). VOLUME 8: ARMY MEDEVAC AVIONICS CAPABILITY STUDY Final Report, Nov. 1972 - Aug. 1973

A. L. Jones, W. A. Dalhamer, and R. J. Kirk Sep. 1973 42 p refs

(Contract NO0014-69-C-0460; NR Proj. 213-072) (AD-773611; Rept-12609-FRI-Vol-8; JANAIR-731001-Vol-8) Avail: NTIS CSCL 06/7

The report presents results of a study to assess the avionics capability of the present generation ARMY MEDEVAC helicopters (UH-1H). The study was based on interviews with experienced MEDEVAC pilots. Analyses were performed to evaluate the baseline avionics and potential improvements against various mission requirements and environmental conditions. The most critical needs identified in the study were night-vision aids and improved navigation capability. Author (GRA)

N74-20060# Naval Air Propulsion Test Center, Trenton, N.J. **DEVELOPMENT OF NDT/I FOR INTEGRAL WING FUEL TANK STRUCTURES USING INFRARED THERMOGRAPHY** Final Report

Anthony P. Pontello Jan. 1974 18 p refs (AD-773466; NAPT-PE-32) Avail: NTIS CSCL 14/2

Infrared thermography was successful in detecting flaws in wing tank structures through changes in temperature pattern under controlled conditions. The flaws detected by Thermovision included voids, cracks, indentations, a loose fuel inspection plate, defective counter sunk screws, material imperfections and damaged honeycomb sections. Laser beams used as a heat source have a limited capability in providing heat patterns of defective materials scanned by Thermovision, but are worthy of further investigation with some modifications. Author (GRA)

N74-20080# Horizons, Inc., Cleveland, Ohio. **DEVELOPMENT OF THERMALLY STABLE POLY (FLUOROALKOXYPHOSPHAZENE) TRANSMISSION SEALS FOR THE UH-1 HELICOPTER** Final Report, 19 Jan. 1972 - 18 Aug. 1973

Kennard A. Reynard, Richard W. Sicks, John C. Vicic, and Selwyn H. Rose Sep. 1973 65 p refs (Contract DAAG46-72-C-0073) (AD-773652; AMMRC-CTR-73-41) Avail: NTIS CSCL 11A

The objective of this program was to develop poly (fluoroalkoxyphosphazene) compounds suitable for service (1100 hrs.) as UH-1 helicopter transmission shaft lip seals over the -65F to 230F range. Significant advances were made in compounding ((CF₃CH₂O)2PN-(HCF₂C₃F₆CH₂O)2PN)n copolymers to meet these objectives. Dynamic tests by National Seal Division of Federal-Mogul Corp. of molded ((CF₃CH₂O)2PN-(HCF₂C₃F₆CH₂O)2PN)n seal formations determined the seals to have over 1000 hours running life. These test results provide

promising evidence of the suitability of poly (fluoroalkoxyphosphazenes) for service as UH-1 helicopter transmission seals. (Modified author abstract) GRA

N74-20161# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

LUBRICATING SYSTEMS OF GAS TURBINE ENGINES

N. T. Domotenko and A. S. Kravets 10 Dec. 1973 149 p refs Transl. into ENGLISH of the book "Maslyanye Sistemy Gazoturbinykh Dvigateli" Moscow, Transport, 1972 p 1-94 (AF Proj. 3048)

(AD-773493; FTD-MT-24-665-73) Avail: NTIS CSCL 11/8

In the book the problems of the arrangement and exploitation of lubricating systems of aviation gas-turbine engines are presented. The working condition of oils and their basic physicochemical and performance properties are examined. The characteristics of petroleum and synthetic oils are given. The requirements for lubricating systems are indicated, and also their fundamental and assembly diagrams are described. The work of a single-circuit, two-circuit and shorted lubricating systems of contemporary aircraft is examined. The features of the operation of lubricating systems of helicopters are given and the parameters of which affect the height power factors of lubricating systems are examined. GRA

N74-20176# RAND Corp., Santa Monica, Calif.

BRANCH-AND-BOUND AND HEURISTIC APPROACHES TO A SEQUENCING PROBLEM WITH TEAM-SIZE REQUIREMENTS

Louis W. Miller Jan. 1974 27 p refs (P-5152) Avail: NTIS HC \$4.50

The work describes the simplest type of static problem with variable team-size requirements. The problem has the following structure: Resources consist of m identical and interchangeable machines, with $m > 1$; and n jobs all available for simultaneous scheduling. Every job has a known processing time requirement, $p_{sub j}$, and a prescribed team size, $r_{sub j}$, that never exceeds m . If the attributes of job j are $p_{sub j}$ and $r_{sub j}$, exactly $r_{sub j}$ machines must be assigned to job j for a continuous interval of length $p_{sub j}$. Interruptions are not permitted. Good scheduling criteria are in terms of minimizing the average of completion times and/or the amount of time required to complete all n jobs. Author

N74-20232# TRW Systems Group, Redondo Beach, Calif.

NUCLEAR INSTRUMENT LANDING SYSTEM Phase 2 Interim Report, Jun. 1971 - Jan. 1973

R. A. Kaminskas 31 Jan. 1973 88 p Sponsored in part by FAA (Contract AT(04-3)-828)

(SAN-828-2) Avail: NTIS HC \$5.45

The analysis, design, construction, and field tests of a prototype Nuclear Instrument Landing System (NILS) are reported. NILS is designed as a short range guidance system for providing highly accurate aircraft position information during the last phases of descent and touchdown for completely automated landings in zero visibility weather. The NILS consists of ground and airborne equipment: the ground equipment is comprised of four beacons of modulated gamma beams and is permanently installed near the runway; the airborne equipment consists of a scintillation detector, four frequency detectors, and signal processing electronics. NSA

N74-20233# Raytheon Co., Wayland, Mass.

MICROWAVE LANDING SYSTEM (MLS) DEVELOPMENT PLAN AS PROPOSED BY RAYTHEON DURING THE TECHNIQUE ANALYSIS AND CONTRACT DEFINITION PHASE OF THE NATIONAL MLS DEVELOPMENT PROGRAM. VOLUME 3: 1.1.1 PERFORMANCE VALIDATION Sep. 1972 366 p refs

(Contract DOT-FA72WA-2803)

(AD-773223; FAA-RD-73-150-Vol-3) Avail: NTIS CSCL

17/7

Volume III discusses multipath, power/error budgets, hardware realization, and system integrity. GRA

N74-20235# Army Electronics Command, Fort Monmouth, N.J.

PREDICTIONS OF INTERFERENCE-REFLECTION ZONES FOR SCANNING BEAM INSTRUMENT LANDING SYSTEMS

Eddie L. Cornelious Jan. 1974 55 p refs
(DA Proj. 1F1-62202-A-97A)

(AD-773822; ECOM-4188) Avail: NTIS CSCL 17/7

To predict reflection/interference zones for scanning beam Instrument Landing Systems, representative situations for an airport environment were selected in developing multipath models. Interfering signals reflected from a large building near a runway will usually be confined to well defined specular regions. The interfering reflecting signal magnitude in these regions can be large. The report presents these regions of interfering reflections in graphic form for various reflecting surface orientations and lateral distances between the radiating source and the reflecting surface. Author (GRA)

N74-20237# Lincoln Lab., Mass. Inst. of Tech., Lexington.

PREDICTION OF OPTICAL LANDING GUIDANCE SYSTEM PERFORMANCE IN CAT. 3-a MINIMUM WEATHER

David G. Kocher 8 Nov. 1973 38 p refs
(Contract F19628-73-C-0002; AF Proj. 649L)

(AD-773830; TN-1973-47; ESD-TR-73-258) Avail: NTIS CSCL 17/7

The feasibility of using a laser optical system to provide precision guidance for the final two miles of aircraft landing approaches in low visibility weather is examined. Since low visibility is caused most frequently by clouds and fog, approximate calculations of the optical signal, scattered light and noise are made as a function of range for various cloud and fog densities. It is concluded that with current laser technology, performance of an optical landing guidance system would be inadequate in the presence of Category III-a minimum visibility clouds and fogs. Author (GRA)

N74-20399# Stanford Research Inst., Menlo Park, Calif.

THE CHEMISTRY OF FUEL DEPOSITS AND THEIR PRECURSORS Final Report, 28 Dec. 1972 - 27 Dec. 1973

Frank R. Mayo, Harold Richardson, and Guillermo D. Maydrga Dec. 1973 45 p refs

(Contract N00019-73-C-0318)

(AD-773630) Avail: NTIS CSCL 21/4

Oxidation and condensation products of a standard jet fuel at 190-200C have been concentrated and fractionated to give materials of average molecular weight of >300 by (1) precipitation from pentane and (2) gel permeation chromatography. Heating fuel with stainless steel wool and oxygen at 200C has given insoluble deposits that can be removed only by heating in air. A deposit from a simulated fuel manifold has been analyzed. Some contemporary work on fuel stability has been reviewed and recommendations for further work toward a useful stability test are presented. (Modified author abstract) GRA

N74-20401# Advisory Group for Aerospace Research and Development, Paris (France).

V/STOL PROPULSION SYSTEMS

Jan. 1974 415 p refs Mostly in ENGLISH; partly in FRENCH Presented at the 42d Meeting of the AGARD Propulsion and Energetics Panel, Schliersee, Germany, 17-21 Sep. 1973 (AGARD-CP-135) Avail: NTIS HC \$23.75

The proceedings of a conference on V/STOL propulsion systems are presented. The subjects discussed include the following: (1) optimum engines for military V/STOL aircraft, (2) engine cycle selection for commercial short takeoff aircraft, (3) requirements for V/STOL propulsion and drive train components, (4) development of advanced technology V/STOL propeller system, (5) engine and aircraft design considerations affecting aircraft noise, (6) characteristics of lifting fans under cross flow

conditions, and (7) operational experience with V/STOL propulsion systems.

N74-20402 Motoren- und Turbinen-Union Muenchen G.m.b.H. (West Germany).

COMPARATIVE APPRAISAL OF PROPULSION SYSTEMS FOR VTOL-AIRCRAFT

Heinrich Leibach In AGARD V/STOL Propulsion Systems Jan. 1974 19 p

An engine-oriented method for a functional description and classification of all existing and future aircraft jet propulsion systems is presented. It is assumed that all aero propulsion systems are made up of assemblies which carry out the thrust generation, thrust augmentation and thrust control functions, with various principles of operation being possible, as well as various combinations of the said assemblies. If these three fundamental functions are determined symbolically and free-of-value, it will be possible to obtain a basic description and a classification of all existing and future engines, via the determination of the energy flows. Moreover, this classification method will permit derivation and description of new, unconventional power plants. Author

N74-20403 Rolls-Royce, Ltd., Bristol (England). Engine Div.

OPTIMUM ENGINES FOR MILITARY V/STOL AIRCRAFT
R. M. Denning and N. A. Mitchell In AGARD V/STOL Propulsion Systems Jan. 1974 13 p

11-28)

The characteristics of propulsion systems for V/STOL low-level close support and air superiority aircraft are discussed. The requirements for optimum engines based on the operational requirements of the aircraft are explained. Charts, graphs, and diagrams are provided to show the evolution of military V/STOL combat aircraft and the associated propulsion systems. Author

N74-20404 Naval Air Systems Command, Washington, D.C.

FORMULATING MILITARY REQUIREMENTS
R. L. VonGerichten In AGARD V/STOL Propulsion Systems Jan. 1974 12 p refs

The formulation of military requirements often includes conflicting elements and may follow several different paths. Many diverse technical concepts which are in varying stages of development must be considered. The formulation process is discussed and some of the technical and design considerations are highlighted. The inception of the Navy's V/STOL Fighter-Attack Program is reviewed together with some indication of the progress on the Navy's Medium V/TOL Program. Both of which are being considered for the Sea Control Ship and other applications. Additional constraints on propulsion system development and thoughts of future propulsion requirements are provided. Author

N74-20405 Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Villaroche (France).

THE MOTORIZATION OF SHORT TAKE-OFF AND LANDING AIRCRAFT [LA MOTORISATION DES AVIONS A DECOLAGE ET A ATERRISSAGE COURTS]

Robert Laurens In AGARD V/STOL Propulsion Systems Jan. 1974 16 p In FRENCH

The operational and environmental requirements for STOL aircraft such as airfield length, noise restrictions and pollution limitations are reviewed and commented on in view of the subsequent engine requirements. The choice of thermodynamic cycle for optimum take-off/cruise thrust matching and economical sfc and the main design parameters influencing fan noise are discussed. Special attention is paid to the improvements in engine handling made possible by the use of variable nozzles and/or variable pitch fans. This allows low thrust levels at high fan speeds, resulting in favorable engine response times, important for baulked landings and thrust reversal. Author

N74-20406 Motoren- und Turbinen-Union Muenchen G.m.b.H. (West Germany).

INVESTIGATION OF THE RELATIVE MERITS OF DIFFERENT

POWER PLANTS FOR STOL-AIRCRAFT WITH BLOWN FLAP APPLICATION

H. Grieb, W. Klusmann, and G. Weist *In* AGARD V/STOL Propulsion Systems Jan. 1974 19 p refs

The relative merits of different air supply systems for STOL-aircraft with blown flap application are investigated. Under consideration are self-sustained supply units, such as gas turbine driven compressors, remote compressors driven with hot gas from the cruise engines and 2 possibilities for off-take of compressed air from the cruise engines. The air supply systems reviewed are compared with respect to the design requirements, the operating behaviour including any reactions on the cruise engines, the sensitivity to component failure and the weight penalty to be expected.

Author

N74-20407 Royal Aircraft Establishment, Bedford (England). A THEORETICAL AND EXPERIMENTAL INVESTIGATION OF THE EXTERNAL-FLOW, JET-AUGMENTED FLAP

P. R. Ashill *In* AGARD V/STOL Propulsion Systems Jan.

The proceedings of a conference on V/STOL propulsion systems are presented. The subjects discussed include the following: (1) optimum engines for military V/STOL aircraft, (2) engine cycle selection for commercial short takeoff aircraft, (3) requirements for V/STOL propulsion and drive train components, (4) development of advanced technology V/STOL propeller system, (5) engine and aircraft design considerations affecting aircraft noise, (6) characteristics of lifting fans under cross flow conditions, and (7) operational experience with V/STOL propulsion systems.

N74-20408 Fiat S.p.A., Turin (Italy). Div. Aviazione. ENGINE CYCLE SELECTION FOR COMMERCIAL STOL AIRCRAFT

Giorgio Feo and Alfredo Capuani (Societa Aeritalia, Turin) *In* AGARD V/STOL Propulsion Systems Jan. 1974 11 p

The cycle and design parameters pertinent to a turbofan to be used for STOL short haul applications have been studied. For the chosen aircraft configuration, the criteria that condition the choice of the cycle, listed in decreasing importance, have been determined as follows: (1) low noise level, (2) high specific thrust to obtain low-weight and reduced-size engines, and (3) low specific fuel consumption (s.f.c.). It is concluded that the controlling factor is the noise level requirement for airports in congested areas. In order to satisfy this and the mission operational requirements the turbofan engine is driven towards medium bypass ratios and high thrust weight ratios but with less emphasis on s.f.c.

Author

N74-20409 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). WIND TUNNEL TESTING WITH ENGINE SIMULATION FOR V/STOL AIRPLANES

R. Wulf and E. Meizer *In* AGARD V/STOL Propulsion Systems Jan. 1974 14 p refs

For the development of STOL and especially for VTOL airplanes with modern engines, wind tunnel testing with adequate jet and engine simulation is of great importance. Current engine systems are classified. Their main characteristics concerning the aerodynamic interference between engine and airplane or between engine and the surrounding flow field are described. Based on these aspects suitable simulation systems are discussed. The power requirement for exact simulation is estimated and in the case of compressed air supply the influence of pressure ratio and temperature is shown. Some simulators developed and used in the last few years illustrate the different testing techniques for compressed air blowing, ejectors, and tip turbine driven fans. Concluding remarks present some proposals for a future collaborative program of work in the field of engine simulation.

Author

N74-20410 General Electric Co., Cincinnati, Ohio. Aircraft Engine Group. RECENT TECHNOLOGY ADVANCES IN THRUST VECTOR-

ING SYSTEMS

Richard P. Taylor and Joseph A. Lander *In* AGARD V/STOL Propulsion Systems Jan. 1974 11 p refs

The important technical challenges that must be overcome in order to make a reality of thrust vectoring of an afterburning engine for a multi-mission aircraft. Two approaches to vectoring - with and without afterburning in lift are described which have been developed to the point that they are available for direct application to an engine development program. In addition, the evaluation/selection/design criteria for vectoring systems have developed to the point where specific design and configuration considerations that are peculiar to VTOL are identified and reasonably well understood. Thus, although the engine and aircraft industry continue the search for and development of even better thrust vectoring systems and installations, it is considered that the fundamental technology and knowhow is available to proceed with a thrust vectored, afterburning engine and aircraft.

Author

N74-20411 Societe Nationale Industrielle Aerospatiale, Paris (France). SHORT HAUL AIRCRAFT ADAPTATION TO THE USE OF SHORT LANDING FIELDS [ADAPTATION MOTEURS-CELLULE DES AVIONS COURTS COURRIERS UTILISANT DES PISTES COURTES]

Pierre Guyot *In* AGARD V/STOL Propulsion Systems Jan. 1974 11 p *In* FRENCH

N74-20412 Army Air Mobility Research and Development Lab., Cleveland, Ohio. BASIC RESEARCH REQUIREMENTS FOR V/STOL PROPULSION AND DRIVE-TRAIN COMPONENTS

John Acurio *In* AGARD V/STOL Propulsion Systems Jan. 1974 14 p

The design of aircraft engines for use with V/STOL aircraft is discussed. Emphasis is placed on the aerodynamic components of the engine. The subjects discussed are as follows: (1) general requirements, (2) compressors, (3) turbines, (4) combustors, and (5) drive train concepts. Graphs of engine performance under various operating conditions are provided.

Author

N74-20413 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany). AERODYNAMIC INTERFERENCE BETWEEN FUSELAGE AND LIFTING JETS EMERGING FROM ITS LOWER PART

G. Viehweger *In* AGARD V/STOL Propulsion Systems Jan. 1974 14 p refs

N74-20414 Army Air Mobility Research and Development Lab., Fort Eustis, Va. RESEARCH TOWARD DEVELOPMENT FEASIBILITY OF AN ADVANCED TECHNOLOGY V/STOL PROPELLER SYSTEM

James Gomez, Jr. and Robert M. Levintan *In* AGARD V/STOL Propulsion Systems Jan. 1974 12 p refs Prepared in cooperation with Hamilton Standard Div., United Aircraft Corp., Windsor Locks, Conn.

N74-20415 Motoren- und Turbinen-Union Muenchen G.m.b.H. (West Germany). THE INFLUENCE OF THE CONTROL CONCEPT FOR V/STOL ENGINES ON THEIR STATIC AND DYNAMIC PERFORMANCE CHARACTERISTICS

K. Bauerfeind and G. Doepner *In* AGARD V/STOL Propulsion Systems Jan. 1974 13 p refs

The decrease of total thrust and the changes of important engine parameters of two-spool bypass engines caused by bleeding air upstream of the combustion chamber for stabilizing and for maneuvering VTOL-aircraft in the hover or transition phase have been investigated. A variation of the engine design parameters turbine inlet temperature, total pressure ratio and bypass ratio

has been considered. In each case three different control concepts have been applied: (1) the power lever position calls for a constant fuel flow, (2) the power lever position calls for a constant HP-compressor speed, and (3) the power lever position calls for a constant turbine inlet temperature. The smallest decrease in total thrust results when the HP-compressor speed is kept constant, when the total pressure ratio is 20 or above and the bypass ratio is between 2 and 10. The design turbine inlet temperature only has a minor effect on this. But, on the other hand, the increase of turbine inlet temperature due to bleeding air is very high. The biggest decrease in total thrust occurs when the turbine inlet temperature is kept constant by the control system and when the engine has a high bypass ratio and also a high design turbine inlet temperature. Author

N74-20416* National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

INTEGRATED PROPULSION/ENERGY TRANSFER CONTROL SYSTEMS FOR LIFT-FAN V/STOL AIRCRAFT

Wallace H. Deckert and L. Stewart Rolls *In* AGARD V/STOL Propulsion Systems Jan. 1974 8 p refs

N74-20417 Pratt and Whitney Aircraft, East Hartford, Conn. **V/STOL DEFLECTOR CONTROL PROFILE STUDY**

R. I. Strough and T. A. Wynosky *In* AGARD V/STOL Propulsion Systems Jan. 1974 13 p

V/STOL deflection of exhaust gases creates static pressure gradients within deflector system ducting which propagate upstream and produce a nonsymmetric back-pressure distribution on the fan. Depending on the deflector design, the fan will experience a higher-than-average back-pressure at one point in the duct, and lower-than-average pressure near the deflector. If this back-pressure distortion is severe enough, engine stability can be compromised. Experimental and analytical studies were conducted to study the back-pressure distortion problem. Small-scale cold flow models of various deflector devices were tested to obtain a parametric mapping of the back-pressure disturbance as a function of bypass ratio, duct Mach number, and deflector geometric parameters. Screens of varying solidity were used to generate total pressure gradients around the duct similar to those generated by the fan. The parametric distortion patterns were then duplicated on a specially designed full-scale fan test rig, and fan surge margin degradation was related to the generated back-pressure profile. The final analysis resulted in the formulation of design ground rules which establish criteria for the disturbance proximity and magnitude that current turbomachinery can tolerate. Author

N74-20418 Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Villaroche (France).

LOW SPEED TURBINE GEAR BOX [TURBINE LENTE CONTRE BOITE D'ENGRENAGES]

Victor Bensimhon *In* AGARD V/STOL Propulsion Systems Jan. 1974 17 p *In* FRENCH

A propulsion system is proposed where a low speed highly loaded turbine driven by two gas generators is coupled directly to the rotor shaft, thus avoiding the heavy gear box. A description is given of the mechanical and aerodynamic characteristics of this propulsion system and its capability to meet the requirements various operating conditions, including high speed flight with propulsion support by the turbojets used as gas generators for the rotor turbine. The system described is compared with a conventional propulsion system with respect to fuel consumption and maintenance cost. Author

N74-20419 Aerospace Research Labs., Wright-Patterson AFB, Ohio, Energy Conversion Lab.

COMPACT THRUST AUGMENTORS FOR V/STOL AIRCRAFT

Brian Quinn *In* AGARD V/STOL Propulsion Systems Jan. 1974 12 p refs

The prospect of undertaking V/STOL and cruise flight with the same powerplant has considerable appeal and can be achieved by proper use of thrust augmenting ejectors. Proper use requires

an ejector that simultaneously satisfies two conflicting requirements: high performance and installation compactness. In addition to elementary design considerations, the following paragraphs discuss the loss mechanisms to which augmentors are most sensitive and describe how they may be manipulated to produce high levels of thrust augmentation in ejectors suitable for V/STOL aircraft. Conclusions are corroborated by the results of experimental investigations of the effects of geometric constraints on the flow structure and performance of thrust augmenting ejectors.

Author

N74-20420 National Research Council of Canada, Ottawa (Ontario), Gas Dynamics Lab.

THRUST PERFORMANCE OF PODDED LIFT-FANS IN CROSSFLOW

R. A. Tyler and R. G. Williamson *In* AGARD V/STOL Propulsion Systems Jan. 1974 14 p refs

N74-20421 National Gas Turbine Establishment, Pyestock (England).

SOME ENGINE AND AIRCRAFT DESIGN CONSIDERATIONS AFFECTING NOISE

D. R. Highton and T. A. Cook (Roy. Aircraft Estab., Farnborough, Engl.) *In* AGARD V/STOL Propulsion Systems Jan. 1974 9 p ref Prepared in cooperation with Roy. Aircraft Estab., Farnborough, Engl.

N74-20422* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

INFLUENCE OF NOISE REQUIREMENTS ON STOL PROPULSION SYSTEM DESIGNS

Raymond J. Rulis *In* AGARD V/STOL Propulsion Systems Jan. 1974 17 p refs

The severity of proposed noise goals for STOL systems has resulted in a new design approach for aircraft propulsion systems. It has become necessary to consider the influence of the noise goal on the design of engine components, engine systems, and the integrated nacelle, separately and collectively, from the onset of the design effort. This integrated system design approach is required in order to effect an optimization of the propulsion and aircraft system. Results from extensive design studies and pertinent test programs are presented which show the effect of noise specifications on component and system design, and the trade-offs possible of noise versus configuration and performance. The design optimization process of propulsion systems for powered lift systems is presented beginning with the component level and proceeding through to the final integrated propulsion system. Designs are presented which are capable of meeting future STOL noise regulations and the performance, installation and economic penalties are assessed as a function of noise level. Author

N74-20423 Dowty Rotol Ltd., Gloucester (England).

THE INFLUENCE OF NOISE REQUIREMENTS ON STOL AIRCRAFT ENGINE DESIGN

D. G. M. Davis *In* AGARD V/STOL Propulsion Systems Jan. 1974 11 p refs

The noise regulations applicable to STOL aircraft are discussed. It is stated that the current aircraft fail to meet the noise regulations and that a reduction of 10 to 15 PNdB must be achieved. An even greater reduction of 25 to 30 PNdB is required to make the aircraft acceptable to city center STOL landing areas. Aircraft performance parameters and flight path considerations which will contribute to a reduction in noise levels are described. A turbofan engine of relatively high bypass ratio fitted with a variable pitch fan is proposed as the basic power plant. Author

N74-20424 Hamilton Standard, Windsor Locks, Conn. Aircraft Systems Dept.

Q-FAN PROPULSION FOR SHORT HAUL TRANSPORTS

Arthur H. Jackson, Jr. *In* AGARD V/STOL Propulsion Systems Jan. 1974 12 p refs

The design and development of quiet fans (Q-FAN) for use with short haul transport aircraft are described. The Q-FAN blade

construction is analyzed to show the effectiveness in noise reduction. The Q-FAN uses variable pitch techniques and is especially effective for thrust reversal operations. The advantages of variable thrust are: (1) superior thrust response and lower engine noise on landing approach, (2) lower fuel consumption at part power conditions, (3) slightly higher thrust and lower fuel consumption at cruise, and (4) blade feathering protection from destructive engine failure. Author

N74-20427 Detroit Diesel Allison, Indianapolis, Ind.
COST OF OWNERSHIP FOR PROPULSION SYSTEM OF POWERED LIFT AIRCRAFT

W. L. McIntire *In* AGARD V/STOL Propulsion Systems Jan. 1974 20 p refs

A discussion of the relationship of advanced propulsion technology for powered lift V/STOL aircraft and the elements of cost of ownership - development, acquisition, and operation and maintenance is presented. Competitive demonstrator programs, component technology versus aircraft, and mission requirements and implementation of design-to-cost programs are discussed as basic cost considerations for the development program element of cost of ownership. Production requirements and manufacturing methods required for new materials and advanced aerodynamic components are presented as the second cost of ownership parameter to provide acquisition costs effectively balanced with performance and cost. Finally, system performance, reliability, and maintainability are evaluated to ensure that the total cost of ownership is commensurate with the job to be done. Author

N74-20428 Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany). Unternehmensbereich Flugzeuge.
PROPULSION SYSTEM OF THE VJ 101 C VTOL AIRCRAFT: PHILOSOPHY AND PRACTICAL EXPERIENCE

Werner Biehl *In* AGARD V/STOL Propulsion Systems Jan. 1974 14 p refs

The design and development of the VJ 101C vertical takeoff aircraft are discussed. Emphasis is placed on optimizing the aircraft configuration with respect to the propulsion system. The special requirements for the engines and intakes to provide a vertical takeoff and supersonic flight capability are analyzed. The problem areas considered are as follows: (1) thrust modulation for attitude control, (2) afterburner thrust for vertical takeoff, (3) hot gas reingestion, (4) ground suction, (5) ground erosion, and (6) noise. Graphs of aircraft and engine performance under various flight conditions are included. Author

N74-20429 De Havilland Aircraft Co., Ltd., Downsview (Ontario). Advanced Research.

THE DEVELOPMENT OF AN INTEGRATED PROPULSION SYSTEM FOR JET STOL FLIGHT RESEARCH

J. A. Conway *In* AGARD V/STOL Propulsion Systems Jan. 1974 15 p refs

The Augmentor-Wing powered lift concept provides the high lift required for STOL terminal operations by means of a close interrelationship between the propulsive and aerodynamic functions of the system. Therefore, the propulsion system is subject to more extensive design requirements than a conventional engine installation. Subsequent to extensive large scale model testing of the concept, general agreement was reached that flight research was feasible and desirable, but in view of the long development times and high costs involved, particularly in respect to engines, means would have to be found to utilize both existing engines and airframe. A de Havilland Buffalo airframe became the basis of the Augmentor-Wing flight research aircraft. The selection, modification and testing of the Rolls-Royce Spey 801 SF which became the basic power plant for the research aircraft are discussed. A description of the associated augmentor ducting is also given, together with an outline of the propulsion aspects of the first phases of testing. Author

N74-20430 Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).

PROBLEMS OF V/STOL AIRCRAFT CONNECTED WITH THE PROPULSION SYSTEM AS EXPERIENCED ON THE

EXPERIMENTAL TRANSPORT AIRCRAFT

M. Lotz and P. Bartels *In* AGARD V/STOL Propulsion Systems Jan. 1974 12 p refs

For V/STOL aircraft, the additional functions of the propulsion system cause some problems which do not occur on CTOL aircraft. As a consequence, the design and operation of V/STOL aircraft is more strongly influenced by propulsion-related problems. These problems are discussed based on the experience with the Do 31 jet lift transport. Hot gas reingestion largely determined the take-off technique adopted for the Do 31. Ground erosion of artificial and natural surfaces is discussed. The most important effects of jet interference in hover and transition are described. The lift engine air intakes have to provide very low thrust losses in hover, low distortion in transition and in-flight starting capability. Some aspects of hover flight control by differential thrust modulation, differential thrust vectoring and reaction control by bleed air are discussed. Finally, the influence of near field noise on the airframe structure and the possibilities of influencing community noise by exploiting the high operational flexibility of V/STOL aircraft are described. Author

N74-20431 Rolls-Royce, Ltd., Bristol (England). Engine Div.
PEGASUS ENGINE OPERATING EXPERIENCE IN THE HARRIER AIRCRAFT

R. J. Cant *In* AGARD V/STOL Propulsion Systems Jan. 1974 18 p

The performance of the Pegasus engine installed in the Harrier aircraft is discussed. The special demands made on an engine for single engine V/STOL close combat application are explained. Operational experiences on the engine are analyzed to show the effects of: (1) the vectoring nozzle system, (2) bird strikes, (3) foreign object damage, (4) aircraft stabilizing, and (5) hot gas reingestion. Author

N74-20432 Vereinigte Flugtechnische Werke-Fokker G.m.b.H., Bremen (West Germany).

THE DEVELOPMENT AND FLIGHT TESTING OF THE PROPULSION SYSTEM OF THE VAK 191 B V/STOL STRIKE AND RECONNAISSANCE AIRCRAFT

Klaus Wieland *In* AGARD V/STOL Propulsion Systems Jan. 1974 12 p

The VAK 191 B has a mixed propulsion system comprising a main lift/cruise engine in the fuselage center and two lift engines installed in the front and the rear section of the fuselage. Bleed air is taken from each engine for aircraft attitude control. Design and development of the propulsion system including the control bleed system will be discussed. The type of control for the propulsion and bleed air system plays an important role towards achieving maximum performance. Extensive model testing has been done to investigate main and lift engine intake performance, lift engine relight capability and hot gas reingestion characteristics of the aircraft. The results have been proven in ground and flight testing. Full scale testing of the bleed air system has been carried out to derive steady state and dynamic characteristics. During ground and flight testing with three prototypes performance, handling and reliability of the propulsion system under VTOL and transition conditions were investigated. Some special results and comparison with predictions are presented. Author

N74-20433 Advisory Group for Aerospace Research and Development, Paris (France).

TECHNICAL EVALUATION REPORT ON 42ND PROPULSION AND ENERGETICS PANEL MEETING ON V/STOL PROPULSION SYSTEMS

H. Grieb and N. A. Mitchell *In* its V/STOL Propulsion Systems Jan. 1974 7 p refs

A technical evaluation of the conference on V/STOL propulsion systems is presented. Comments are prepared concerning the papers that were submitted and the round table discussions are summarized. Recommendations are submitted concerning the future course of actions to be taken for design and development of V/STOL aircraft and engines. The questions which were used as a guide line and the main points of discussion are briefly answered. P.N.F.

N74-20445 European Space Research Organization, Paris (France).

THE PERFORMANCE BEHAVIOUR OF A BYPASS ENGINE IN MULTIPARAMETER CONTROL

Heinrich Dissen *In its Behaviour of the Turbine Engine* Feb. 1974 p 49-66 Transl. into ENGLISH from "Verhalten des Turbotriebwerks", DGLR, Cologne, report DLR-Mitt-73-05, Jan. 1973 p 55-72

Some examples are given to show the influence of the variation of both nozzle surfaces and fuel throughout at given thrust and other boundary conditions on the engine parameters of a two-cycle turbojet engine with large bypass ratio without primary and secondary flow mixing. To this end, a computation method was developed for describing the performance of engines with multiparameter control. The advantages of multiparameter control are summarized. The disadvantages are: the system is more complicated, adjustable nozzles add to the engine weight, and accurate measurements are necessary for determining the engine parameters. ESRO

N74-20450# Air Force Systems Command, Wright-Patterson AFB, Ohio, Foreign Technology Div.

MIXING OF GAS AND AIR JETS IN JET ENGINES

A. Hartmann 19 Dec. 1973 17 p refs Transl. into ENGLISH from Z. Flugwiss. (West Germany), v. 19, no. 4, Apr. 1971 p 158-163

(AD-773908; FTD-HC-23-478-74) Avail: NTIS CSCL 21/5

At the current state of engine development, an improvement in specific consumption or an increase in thrust concentration can be obtained only with relatively great effort, e.g. by improving partial efficiencies and increasing the turbine inlet temperature by using better blade materials and introducing more efficient cooling techniques. Jet mixing is a relatively simple matter and results in a remarkable improvement in efficiency. By means of the gas-dynamic energy transport in jet engines, the noise of the discharged gas jets can be abated. (Modified author abstract) GRA

N74-20451# Colt Industries, Inc., West Hartford, Conn. Chandler Evans Control Systems Div.

ADVANCED ENGINE CONTROL PROGRAM Final Report

R. J. Hearn, M. A. Cole, and A. H. White Nov. 1973 96 p refs

(Contract DAAJ02-72-C-0084; DA Proj. 1G1-62207-AA-71) (AD-773660; R-492-45; USAAMRD-LR-73-81) Avail: NTIS CSCL 21/5

Development of electronic control and centrifugal pump technology for use in future small turboshaft engines is reported. Redesign of the electronic computer using micropowered analog and digital components has resulted in a reduction in electrical power dissipation from 60 to about 7 watts, which virtually eliminates self heating problems. Supply voltage and noise sensitivities have also been substantially reduced. The induced vibration has been limited to less than 30 g's over the complete vibration spectrum. Increasing the pump speed from 37,500 to 55,000 rpm to reduce disc friction has resulted in a 50% reduction in the fuel temperature rise. (Modified author abstract) GRA

N74-20452# Air Force Systems Command, Wright-Patterson AFB, Ohio, Foreign Technology Div.

CHARACTERISTICS OF CASCADES OF SLOTTED SECTIONS OF ADJUSTABLE GUIDE VANES OF AXIAL-FLOW TURBINES

Yu. S. Kustarev 17 Jan. 1974 14 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Mashinostr. (Moscow), no. 12, 1971 p 88-92

(AD-773900; FTD-HT-23-777-74) Avail: NTIS CSCL 21E

The report deals with the aerodynamic characteristics of foil lattices of slotted sections, developed for adjustable guide vanes of vehicle gas-turbine engines. A close coincidence was observed between the aerodynamic indicators of slotted and non-slotted foil lattices. GRA

N74-20453# Air Force Systems Command, Wright-Patterson AFB, Ohio, Foreign Technology Div.

PROBLEM OF THE APPLICATION OF TURBOFAN ENGINES IN AIR TRANSPORT. METHODS OF INCREASE IN EFFICIENCY OF TURBOFAN ENGINE WITH HIGH BYPASS RATIOS

A. L. Kiyachkina 28 Nov. 1973 158 p refs Transl. into ENGLISH from Tr. Rzhskii Inst. inzh. Gradzhanskoi Aviatcii (USSR), no. 174, 1971 p 1-153

(AD-773292; FTD-MT-24-661-73) Avail: NTIS CSCL 21/5

The report contains Soviet generated articles relative to the operating parameters of gas turbine engines, thermodynamic functions, gas dynamics, and acoustic characteristics. GRA

N74-20527# Los Alamos Scientific Lab., N.Mex.

TEMPORAL OBSERVATIONS OF THE LAMBDA 5303 EMISSION LINE PROFILE DURING THE 74 MINUTE TOTALITY FROM THE CONCORDE SST AT THE 30 JUNE 1973 TOTAL SOLAR ECLIPSE: PRELIMINARY INTENSITY VARIATIONS ABOVE AN ACTIVE REGION

D. H. Liebenberg and M. M. Hoffman 28 Aug. 1973 9 p refs Presented at Intern. Astron. Union Symp. on Coronal Disturbances, Surfers Paradise, Australia, 3 Sep. 1973 Sponsored by AEC

(LA-UR-73-1304; Conf-730953-1) Avail: NTIS HC \$3.00

Apparatus was designed for installation on the Concorde SST to provide high resolution emission line profiles at the June 30, 1973 total solar eclipse. A prime objective was to obtain profiles that could be used to detect the coronal response to the 5 min periodicities observed in the solar photosphere. Stability of the sky scattered light, drastic reduction of seeing effects enhanced the value of the exceptional opportunity. Preliminary results are discussed for a single region on the limb, above an active sunspot group. Author (NSA)

N74-20572# National Aerospace Lab., Tokyo (Japan).

FLEXURAL RIGIDITY OF A THIN WALLED BUILD-UP ROTOR FOR JET ENGINE. MEASUREMENT BY STATIC LOAD TEST AND VIBRATION TEST AND CALCULATION BY FINITE ELEMENT METHOD

Toshio Miyachi, Akinori Ogawa, Shoji Hoshiya, and Yasushi Sofue Jul. 1973 17 p refs In JAPANESE; ENGLISH summary (NAL-TR-329) Avail: NTIS HC \$4.00

Results of flexural rigidity tests and flexural vibration tests of a thin walled built-up rotor for a single spool jet engine are presented. Calculations of deformation of the rotor under similar loading and supporting conditions occurring in the tests are carried out by the finite element method and compared with the experimental values. Results show that: (1) The thin walled built-up rotor has very low flexural rigidity compared with the value computed by simple beam theory. (2) The values of deformation calculated by the finite element method agree well with the experimental values by proper idealization of the built-up structure. (3) Structural damping of the built-up rotor is much larger than for rotors having a solid or welded structure. Author

N74-20579# Pisa Univ. (Italy). Inst. of Aeronautics.

FATIGUE BEHAVIOUR OF HAT SECTION STRINGER STIFFENED PANELS COMPRESSED IN THE POST-BUCKLING RANGE Final Technical Report

A. Salvetti and C. Casarosa Jul. 1973 89 p refs

(Contract DAJA37-72-C-1280)

(AD-773672) Avail: NTIS CSCL 11/6

The report presents results of research on the fatigue behaviour of riveted hat section stringer stiffened panels which buckle under constant amplitude fatigue loading. Panels made with 2024-T3 as well as 7075-T6 Aluminum alloys were tested, and cracks were found to develop systematically in the stringer top plate along the rivet lines. It was demonstrated that the tensile bending stresses which take place in the stringer when the sheet cover buckles are responsible for crack initiation. The fatigue cracked panels were statically tested. Results are discussed. GRA

N74-20591* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

JET ENGINE EXHAUST EMISSIONS OF HIGH ALTITUDE COMMERCIAL AIRCRAFT PROJECTED TO 1990

Jack Grobman and Robert D. Ingebo Washington Mar. 1974 86 p refs
(NASA-TM-X-3007; E-7822) Avail: NTIS HC \$4.00 CSCL 21B

Projected minimum levels of engine exhaust emissions that may be practicably achievable for future commercial aircraft operating at high-altitude cruise conditions are presented. The forecasts are based on: (1) current knowledge of emission characteristics of combustors and augmentors; (2) the status of combustion research in emission reduction technology; and (3) predictable trends in combustion systems and operating conditions as required for projected engine designs that are candidates for advanced subsonic or supersonic commercial aircraft fueled by either JP fuel, liquefied natural gas, or hydrogen. Results are presented for cruise conditions in terms of both an emission index (g constituent/kg fuel) and an emission rate (g constituent/hr).

Author

N74-20630# Texas Transportation Inst., College Station. TEXAS AIRPORT SYSTEMS PLAN - AIR PASSENGER DEMAND MODEL: MODEL TEST AND EVALUATION

Ralph E. Foster Jan. 1973 64 p refs Sponsored by FAA and Office of Governor, Austin, Tex.
(AD-772471) Avail: NTIS CSCL 01/2

The Texas Airport System Plan (TASP) is intended to identify locations where facility deficiencies are anticipated in the airport system of the State of Texas and to develop alternative courses of action designed to prevent the potential deficiencies. A deficiency is identified when, at some future time within the planning horizon, demand upon a facility exceeds its capacity. Total demand has been divided into three areas--commercial air passenger, cargo, and general aviation--which have been forecasted for planning subdivisions of the State. Forecasts of commercial air passenger demand have been prepared through the use of a complex model. The purpose of this report is to present the rationale for the selection of the methodology employed in the design and development of the Air Passenger Demand Model, to review the procedures used to test and calibrate the model, and to evaluate the model and the forecasts which it produces.

GRA

N74-20636# Aeronautical Research Inst. of Sweden, Stockholm.

A COMPUTER PROGRAM FOR THE PREDICTION OF AERODYNAMIC CHARACTERISTICS OF WING-BODY-TAIL COMBINATIONS AT SUBSONIC AND SUPERSONIC SPEEDS, PART 2

S. Anders and L. Gustavsson Nov. 1972 120 p refs
(FFA-AU-635-Pr-2) Avail: NTIS HC \$9.00 CSCL 01A

A computer program for calculation of the aerodynamic characteristics of wing-body combinations at subsonic and supersonic speeds is described. The aerodynamic theory is outlined and several calculated examples with comparisons to experimental results are shown. A description of the computer program is provided together with a users manual. The results obtained show that the method is a very valuable tool for analysis and design purposes.

Author

N74-20637* National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

PRELIMINARY RESULTS OF FLIGHT TESTS OF VORTEX ATTENUATING SPLINES

Earl C. Hastings, Jr., Robert E. Shanks, Robert A. Champine, W. Latham Copeland, and Douglas C. Young Apr. 1974 41 p refs

(NASA-TM-X-71928) Avail: NTIS HC \$5.25 CSCL 01A

Flight tests have been conducted to evaluate the effectiveness of a wingtip vortex attenuating device, referred to as a spline. Vortex penetrations were made with a PA-28 behind a C-54 aircraft with and without wingtip splines attached and the resultant rolling acceleration was measured and related to the roll

acceleration capability of the PA-28. Tests were conducted over a range of separation distances from about 5 nautical miles (n. mi.) to less than 1 n. mi. Preliminary results indicate that, with the splines installed, there was a significant reduction in the vortex induced roll acceleration experienced by the PA-28 probe aircraft, and the distance at which the PA-28 roll control became ineffective was reduced from 2.5 n. mi. to 0.6 n. mi., or less. There was a slight increase in approach noise (approximately 4 db) with the splines installed due primarily to the higher engine power used during approach. Although splines significantly reduced the C-54 rate of climb, the rates available with four engines were acceptable for this test program. Splines did not introduce any noticeable change in the handling qualities of the C-54.

Author

N74-20638* National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

PRELIMINARY STATIC TESTS OF A SIMULATED UPPER-SURFACE BLOWN JET-FLAP CONFIGURATION UTILIZING A FULL-SIZE TURBOFAN ENGINE

James P. Shivers and Charles C. Smith, Jr. Mar. 1974 44 p
(NASA-TM-X-71931) Avail: NTIS HC \$5.25 CSCL 01A

The investigation was conducted to evaluate the static turning performance and the pressure and temperature environment of an upper-surface-blown wing and flap utilizing a small turbofan engine. The tests involved modifications of the engine primary nozzle designed to alleviate high temperature problems on the wing and flaps and yet provide acceptable static turning performance over the desired range of flap deflections and thrust conditions.

Author

N74-20639# Advisory Group for Aerospace Research and Development, Paris (France).

TECHNICAL EVALUATION REPORT ON AGARD FLIGHT MECHANICS PANEL SYMPOSIUM ON FLIGHT IN TURBULENCE

W. S. Aiken, Jr. (NASA), Washington and D. Lean (Roy. Aircraft Estab., Bedford, Engl.) Feb. 1974 10 p Conf. held at Woburn Abbey, Engl., 14-18 May 1973
(AGARD-AR-67) Avail: NTIS HC \$4.00

The proceedings of a conference on the effects of atmospheric turbulence on flight characteristics are presented. The subjects discussed include the following: (1) turbulent environment, (2) operational problems, (3) design criteria, and (4) artificial aids for flight improvement. One conclusion is that there is a critical need for cross correlation measurements between various low atmosphere turbulence components. Additional discussion were held concerning wake vortex research for wake vortex detection and avoidance.

Author

N74-20642# National Aerospace Lab., Amsterdam (Netherlands). Scientific Service and Special Project Div.

A NUMERICAL METHOD FOR THE DETERMINATION OF THE VORTEX SHEET LOCATION BEHIND A WING IN INCOMPRESSIBLE FLOW

T. E. Labrujere 7 Jul. 1972 52 p refs Sponsored by Neth. Agency for Aerospace Programs (NIVR)
(NLR-TR-72091-U) Avail: NTIS HC \$5.75

Aiming at the determination of interference effects due to the wake of the wing, a numerical method was developed for the calculation of the vortex location behind a thick lifting wing. It may be considered as an extension of the NLR panel method for the determination of the pressure distribution on lifting wing-body combinations in subsonic flow. It comprises an iterative procedure for the determination of the vortex sheet location represented by discrete vortices for given onset flow conditions. Some features of the method, such as the effect of streamwise stepsize and discretization, were investigated numerically. A limited comparison was made with experimental results taken from work in progress.

Author (ESRO)

N74-20644# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
AERODYNAMIC COMPARISON OF TWO DOUBLE-

SLOTTED RUDDERS M.S. Thesis

Tyler B. Huneycutt, III Dec. 1973 150 p refs
(AD-774432; GAM/AE/73A-10) Avail: NTIS CSCL 01/3

Double-slotted rudders (DSR), proposed for an Advanced Medium STOL Transport by the L. O. M. Corporation and Convair Division of General Dynamics Corporation, were tested in a 7 X 10 ft wind tunnel at a dynamic pressure of 17.0 psf and a Reynolds number of 2,000,000. The rudders were tested in 5 deg increments of deflection from 0 to 40 deg, and at sidewash angles varying from -10 to +10 deg. In the range of deflection angles from 0 to stall, the Convair DSR design (DSR1) produced slightly higher side-forces; however, the L. O. M. DSR design (DSR2) stalled at a higher deflection angle than DSR1. Maximum side-force produced by DSR1 and DSR2 were almost exactly equal. The side-force versus sidewash angle curves were linear. A rudder deflection schedule for DSR2 was devised which produced minimum drag and linear side-forces. (Modified author abstract) GRA

N74-20645# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

APPLICATION OF THE LATERAL AND LONGITUDINAL (COUPLED) EQUATIONS OF MOTION TO AN INERTIALLY-SLENDER AIRCRAFT IN UNSYMMETRIC, RECTILINEAR FLIGHT M.S. Thesis

Charles W. McConnell Dec. 1973 93 p refs
(AD-774435; GAM/MC/73A-3) Avail: NTIS CSCL 01/1

The dynamics of an aircraft in flight may be represented by a set of six coupled non-linear equations of motion that are usually linearized about a symmetrical equilibrium position and divided into uncoupled lateral and longitudinal equations. The present high speed fighter aircraft requires a configuration that is prone to lateral instabilities which are not analyzed by the uncoupled equations. Solution of the coupled equations of motion is of considerable value because the cross-coupling effects may be determined and analyzed. For this study the F-4D aircraft was chosen as the physical model because of known stability difficulties. (Modified author abstract) GRA

N74-20646* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

AIRFLOW CONTROL SYSTEM FOR SUPERSONIC INLETS Patent

Glenn A. Mitchell, inventor (to NASA) and Bobby W. Sanders Issued 26 Mar. 1974 6 p Filed 11 Jun. 1971 Supersedes N71-34017 (09 - 21, p 3375)
(NASA-Case-LEW-11188-1; US-Patent-3,799,475;
US-Patent-Appl-SN-152328; US-Patent-Class-244-53B;
US-Patent-Class-137-15.1; US-Patent-Class-137-15.2) Avail:
US Patent Office CSCL 01B

In addition to fixed and variable bleed devices provided for controlling the position of a terminal shock wave in a supersonic inlet, a plurality of free piston valves are disposed around the periphery of a cowl of a supersonic engine inlet. The free piston valves are disposed in dump passageways, each of which begin at a bleed port in the cowl that is located in the throat region of the inlet, where the diameter of the centerbody is near maximum, and terminates at an opening in the cowl adjacent a free piston valve. Each valve is controlled by reference pressure. Official Gazette of the U.S. Patent Office

N74-20647 Escher Technology Associates, St. Johns, Mich. PROSPECTS FOR LIQUID HYDROGEN FUELED COMMERCIAL AIRCRAFT

William J. D. Escher Sep. 1973 39 p refs
(PR-37) Copyright. Avail: Issuing Activity

The use of hydrogen as a fuel for aircraft propulsion is discussed. The benefits of hydrogen with respect to air pollution reduction are analyzed. Liquid hydrogen as a potential future aviation fuel is considered to be the only practical chemical fuel producible from ultimate nonfossil energy primary sources. The aerodynamic configurations and aircraft systems involved in hydrogen propulsion are described and illustrated. The facilities and processes for commercial production of hydrogen are reported. Author

N74-20648 Oklahoma Univ., Norman.

AERODYNAMICS OF CHANNEL AND RING WINGS Ph.D. Thesis

Roger Lair Smith 1973 259 p
Avail: Univ. Microfilms Order No. 74-6986

The results of a deflected streamtube theory for the lift and induced drag of isolated ring wings are briefly reviewed, and a similar theory for channel wings is presented. The ring wing theory, and methods derived from its general conclusions, are compared with other theoretical derivations and with experimental data. A wind tunnel test of two channel wings of aspect ratio 1.0 and 2.8 is described, and the data are compared with the channel wing deflected streamtube theory. It is shown that the ring wing theory yields good agreement with experiment and with other developments, but the channel wing deflected streamtube theory does not. The experimental results for channel wings and ring wings indicate that these wings achieve span efficiency factors of approximately 1.5 and 2.0, respectively. A lifting arc theory for channel wings is derived and shown to agree with the experimental data. Dissert. Abstr.

N74-20651* National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

ACOUSTIC LOADS ON AN EXTERNALLY BLOWN FLAP SYSTEM DUE TO IMPINGEMENT OF A TF-34 JET ENGINE EXHAUST

James A. Schoenster 10 Apr. 1974 20 p Presented at the 87th Meeting of the Acoustical Soc. of Am., New York, 23-26 Apr. 1974

(NASA-TM-X-71950) Avail: NTIS HC \$4.00 CSCL 01C

One of the powered lift systems currently being considered for use on STOL vehicles obtains additional lift by impinging the flow of a jet exhaust on the flaps and turning it downward. This direct impingement subjects large areas of the flap to the fluctuating pressure loads of the turbulent jet flow; these loads have the potential for causing high vibration levels and sonic fatigue failures. A test was conducted on a full-scale mockup of an externally blown flap system, which consisted of a TF-34 engine and a section of a wing having a triple-slotted flap. Data were obtained and evaluated on the fluctuating pressures on the flaps and it is the purpose of this paper to present some of the results describing the loads. Author

N74-20652* National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

EFFECT OF TRAILING-EDGE FLAP DEFLECTION ON THE LATERAL AND LONGITUDINAL-STABILITY CHARACTERISTICS OF A SUPERSONIC TRANSPORT MODEL HAVING A HIGHLY-SWEPT ARROW WING

Vernard E. Lockwood 19 Mar. 1974 55 p refs
(NASA-TM-X-71936) Avail: NTIS HC \$5.75 CSCL 01C

A low-speed investigation has been made on a highly-swept wing model having a thickened leading edge to determine the effect of inboard trailing-edge flaps on the characteristics of the model in pitch and sideslip. The tests were made at a Mach number of 0.227 which corresponds to a Reynolds number of about 5.53 million based on the reference chord. The results showed that deflection of the trailing-edge flaps decreased the roll due to sideslip by about 20 percent at a landing lift coefficient of 0.5. The directional-stability parameter, was increased by deflection of the flaps and the range of lift coefficients over which it was positive was also increased. The longitudinal stability characteristics of the model without leading-edge devices were improved by increased flap deflection, that is, the pitch-up tendency was delayed to higher lift coefficients. The lift coefficient increment resulting from the 15 deg flap deflection compared favorably with that predicted. Author

N74-20654* National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

AERONAUTICAL FUEL CONSERVATION POSSIBILITIES FOR ADVANCED SUBSONIC TRANSPORTS

Albert L. Braslow and Allen H. Whitehead, Jr. 20 Dec. 1973 15 p

(NASA-TM-X-71927) Avail: NTIS HC \$4.00 CSCL 01C

The anticipated growth of air transportation is in danger of being constrained by increased prices and insecure sources of petroleum-based fuel. Fuel-conservation possibilities attainable through the application of advances in aeronautical technology to aircraft design are identified with the intent of stimulating NASA R and T and systems-study activities in the various disciplinary areas. The material includes drag reduction; weight reduction; increased efficiency of main and auxiliary power systems; unconventional air transport of cargo; and operational changes. Author

N74-20655*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

PRESSURE DISTRIBUTION OF A TWIN-ENGINE UPPER-SURFACE BLOWN JET-FLAP MODEL

Charles C. Smith, Jr. and Lucy C. White Mar. 1974 41 p refs

(NASA-TM-X-71937) Avail: NTIS HC \$5.25 CSCL 01C

An investigation has been made to determine the chordwise and spanwise pressure distributions of a small-scale upper-surface blown jet-augmented flap STOL model. The model was powered by two simulated high-bypass-ratio turbofan engines mounted ahead of and above an unswept-untapered wing in a nacelle having a rectangular nozzle. The results of the investigation are presented as tabulated and plotted chordwise pressure distribution coefficients for nine spanwise stations. Author

N74-20656*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

FREE-FLIGHT WIND TUNNEL INVESTIGATION OF A FOUR-ENGINE SWEPTWING UPPER-SURFACE BLOWN TRANSPORT CONFIGURATION Interim Report

Lysle P. Parlett Mar. 1974 36 p refs

(NASA-TM-X-71932) Avail: NTIS HC \$5.00 CSCL 01C

The dynamic stability characteristics of a four-engine turbofan transport model having an upper-surface blown-jet flap have been investigated by means of the free-flight technique in the Langley full-scale tunnel. The flight characteristics of the model were investigated through a range of lift coefficients from 3 to 8 with all four engines operating and with one outboard engine not operating. Static characteristics were investigated by conventional power-on force tests over the flight-test angle-of-attack range and through the stall. Author

N74-20657*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

EXPLORATORY TESTS OF A SIMPLE AERO-MECHANICAL RIDE COMFORT SYSTEM FOR LIGHTLY LOADED AIRCRAFT

Donald E. Hewes and Eric C. Stewart 14 Feb. 1974 20 p refs

(NASA-TM-X-71921) Avail: NTIS HC \$4.00 CSCL 01C

Some exploratory wind tunnel and radio-controlled free-flight tests were made with a small high-wing airplane model (1.23m wing span) to study the concept of a simple aero mechanical system intended to alleviate gust loads and improve ride comfort of lightly loaded aircraft. The system consisted essentially of the outer portions of each wing being hinged in the chordwise direction and connected directly to the wing flaps using internal counter weights to provide neutral mass balance. When the wing experienced a change in velocity or angle of attack, the movable wing panels, acting as sensors and flap actuators, deflected in response to the changes in lift on the wing. The corresponding movements of the interconnected flaps tended to reduce the changes in the wing lift. Author

N74-20658*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

EXTERNAL STORE EFFECTS ON THE STABILITY OF FIGHTER AND INTERCEPTOR AIRPLANES

M. Leroy Spearman and Wallace C. Sawyer Mar. 1974 30 p refs

(NASA-TM-X-71935) Avail: NTIS HC \$4.50 CSCL 01C

Some criteria for external carriage of missiles for fighter aircraft intended for aerial combat missions and for fighter-

interceptor missions are considered. The mission requirements discussed include the short-range fighter-interceptor, the short-range interceptor, the medium-range interceptor, and the long-range interceptor. Missiles types considered to be compatible with the various point mission designs include the short-range missile, the medium-range missile, and the long-range missile. From the study, it appears that point mission design aircraft can be arranged in such a way that the required external-store arrangement will not impair the stability of the aircraft. An extensive reference list of NASA external store research is included. Author

N74-20659*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

THE NOISE ENVIRONMENT OF A SCHOOL CLASSROOM DUE TO THE OPERATION OF UTILITY HELICOPTERS

David A. Hilton and Robert J. Pegg 24 Apr. 1974 16 p refs Presented at 87th Meeting of the Acoust. Soc. of Am., New York City, 24 Apr. 1974

(NASA-TM-X-71957) Avail: NTIS HC \$4.00 CSCL 01C

Noise measurements under controlled conditions have been made inside and outside of a school building during flyover operations of four different helicopters. The helicopters were operated at a condition considered typical for a police patrol mission. Flyovers were made at an altitude of 500 ft and an airspeed of 45 miles per hour. During these operations acoustic measurements were made inside and outside of the school building with the windows closed and then open. The outside noise measurements during helicopter flyovers indicate that the outside db(A) levels were approximately the same for all test helicopters. For the windows closed case, significant reductions for the inside measured db(A) values were noted for all overflights. These reductions were approximately 20 db(A); similar reductions were noted in other subjective measuring units. The measured internal db(A) levels with the windows open exceeded published classroom noise criteria values; however, for the windows-closed case they are in general agreement with the criteria values. Author

N74-20660*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

EFFECT OF ADVANCED AIRCRAFT NOISE REDUCTION TECHNOLOGY ON THE 1990 PROJECTED NOISE ENVIRONMENT AROUND PATRICK HENRY AIRPORT

Jimmy M. Cawthorn and Christine G. Brown 19 Feb. 1974 38 p refs

(NASA-TM-X-71953) Avail: NTIS HC \$5.00 CSCL 01C

A study has been conducted of the future noise environment of Patrick Henry Airport and its neighboring communities projected for the year 1990. An assessment was made of the impact of advanced noise reduction technologies which are currently being considered. These advanced technologies include a two-segment landing approach procedure and aircraft hardware modifications or retrofits which would add sound absorbent material in the nacelles of the engines or which would replace the present two- and three-stage fans with a single-stage fan of larger diameter. Noise Exposure Forecast (NEF) contours were computed for the baseline (nonretrofitted) aircraft for the projected traffic volume and fleet mix for the year 1990. These NEF contours are presented along with contours for a variety of retrofit options. Comparisons of the baseline with the noise reduction options are given in terms of total land area exposed to 30 and 40 NEF levels. Results are also presented of the effects on noise exposure area of the total number of daily operations. Author

N74-20661*# Boeing Commercial Airplane Co., Seattle, Wash. **THE 727 AIRPLANE SIDE INLET LOW-SPEED PERFORMANCE CONFIRMATION MODEL TEST FOR REFANDED JT8D ENGINES**

A. L. Schuehle Mar. 1974 82 p refs

(Contract NAS3-17842)

(NASA-CR-134609; BCAC-D6-41521) Avail: NTIS HC \$7.25 CSCL 01C

The results of a low-speed wind tunnel test of a 0.3 scale model 727 airplane side inlet for JT8D-100 engines are

presented. The objectives of the test were to develop lines for a full-scale flightworthy inlet, to evaluate inlet total pressure recovery and steady-state total pressure distortion, and to obtain model-scale distortion data which can be used in the assessment of the compatibility of the inlet with the JT8D-100 series engines. A secondary objective was to obtain internal/external cowl static pressures for the determination of nacelle loads. Two basic inlet models were tested at static, forward speed, angle-of-attack (inflow angle), and cross-wind conditions. One model was with and one without an acoustic ring. Two modifications to the models were also tested, one with the ring closer to the inlet throat and one with a larger lip. Test measurements consisted of inlet surface static pressure, engine face total pressure, inlet airflow, tunnel total pressure, tunnel total temperature and tunnel velocity. Total pressure traverses were taken directly behind the ring and strut. No dynamic measurements were taken. Author

**N74-20662*# Hughes Helicopters, Culver City, Calif.
COMPONENT NOISE VARIABLES OF A LIGHT OBSERVATION HELICOPTER**

Frank Robinson [1973] 89 p refs
(Contract NAS2-7254)
(NASA-CR-114761; HH-73-41) Avail: NTIS HC \$7.50 CSCL 01C

A test program was conducted to isolate and evaluate the individual noise sources of a light helicopter. To accomplish this, the helicopter was mounted on a special test rig, at a 6-foot skid height, in a simulated hover. The test rig contained by dynamometer for absorbing engine power and an exhaust silencing system for reducing engine noise. This test set-up allowed the various components of the helicopter to be run and listened to individually or in any combination. The sound pressure level was recorded at a point 200 feet from the helicopter as the component parameters were systematically varied. The tests were conducted in an open area, during the middle of the night, with no wind, and with all other known variables either eliminated or kept as constant as possible. Author

**N74-20663*# Hughes Helicopters, Culver City, Calif.
NOISE LEVELS OF OPERATIONAL HELICOPTERS OF THE OH-6 TYPE DESIGNED TO MEET THE LOH MISSION**

R. A. Wagner [1973] 70 p refs
(Contract NAS2-7254)
(NASA-CR-114760; HH-74-28) Avail: NTIS HC \$6.50 CSCL 01C

Formulas relating overall sound pressure level (OASPL) to parameters such as horsepower required, tip speed, and thrust for main and tail rotors are presented for standard and quieted helicopters. Formulas relating OASPL to engine parameters such as horsepower output and percent power turbine rpm are presented for unmuffled and muffled engines. The linear scale was used in preference to any of the weighted scales because it resulted in more consistent agreement with the test data when the SPL is expressed in the usual parameters of tip speed, thrust generated and power required. It is recognized that the linear scale does not adequately reflect hearing response, and hence is not a good absolute measure for detection by humans. However, linear OASPL is believed to be useful as a relative means of comparing noise level variations of individual components in similar helicopters with reasonably modest design changes. Author

N74-20664# National Transportation Safety Board, Washington, D.C.

AIRCRAFT ACCIDENT REPORT: BRIEF FORMAT, US CIVIL AVIATION, ISSUE NO. 3 OF 1973 ACCIDENTS

25 Feb. 1974 522 p
(NTSB-BA-74-1) Avail: NTIS HC \$29.25

This publication contains selected aircraft accident reports, in brief format, occurring in U. S. civil aviation operations during calendar year 1973. The 900 General Aviation and 22 Air Carrier Accidents contained in this publication represent a random selection. This publication is issued irregularly, normally six times each year. The brief format presents the facts, conditions, circumstances, and probable cause(s) for each accident. Additional

statistical information is tabulated by type of accident, phase of operation, kind of flying injury index, aircraft damage, conditions of light, pilot certificate, injuries, and causal factors. Author

N74-20665# National Transportation Safety Board, Washington, D.C.

AIRCRAFT ACCIDENT REPORT: DELTA AIR LINES, INCORPORATED, DOUGLAS DC-9-31, N975-NE, BOSTON, MASSACHUSETTS, 31 JULY 1973

7 Mar. 1974 76 p
(NTSB-AAR-74-3) Avail: NTIS HC \$7.00

A DC-9-31, crashed while executing an instrument landing system approach to runway 4R on the Logan International Airport, in Boston, Massachusetts. There were 83 passengers, 5 crewmembers and a cockpit observer on board. All occupants, except one passenger, were killed in the crash. The lone survivor, who had been injured critically, died later. The aircraft struck a seawall about 165 feet to the right of the extended runway centerline and about 3,000 feet short of the runway displaced threshold. The aircraft was destroyed. The National Transportation Safety Board determines that the probable cause of the accident was the failure of the flightcrew to monitor altitude and to recognize passage of the aircraft through the approach decision height during an unstabilized precision approach conducted in rapidly changing meteorological conditions. The unstabilized nature of the approach was due initially to the aircraft's passing the outer marker above the glide slope at an excessive airspeed and thereafter compounded by the flightcrew's preoccupation with the questionable information presented by the flight director system. The poor positioning of the flight for the approach was in part the result of nonstandard air traffic control services. Author

N74-20666*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

LATERAL STATIC AND DYNAMIC AERODYNAMIC PARAMETERS OF THE KESTREL AIRCRAFT (XV-6A) EXTRACTED FROM FLIGHT DATA

William T. Suit and James L. Williams Washington Apr. 1974 43 p refs
(NASA-TN-D-7455; L-9176) Avail: NTIS HC \$3.25 CSCL 01C

Flight test data have been used to extract the lateral static and dynamic aerodynamic parameters of the Kestrel aircraft. The aircraft configurations included thrust-jet angles of 0 deg, 15 deg, and 30 deg, and the test Mach numbers were 0.43, 0.62, and 0.82. The results showed that most of the parameters varied linearly with trim normal-force coefficient. The directional stability parameter showed a small increase with increasing trim normal-force coefficient and also with nozzle deflection. The effective-dihedral parameter, the damping-in-roll parameter, and damping-in-yaw parameter all increased (became more negative) with increasing trim normal-force coefficient. For the latter three parameters, the effect of nozzle deflection was dependent on the trim normal-force coefficient. Author

**N74-20667*# General Electric Co., Evendale, Ohio.
THE EFFECT OF ENGINE COMPONENT NOISE ON V/STOL AIRCRAFT NOISE CONTOURS**

R. G. Fogg Feb. 1974 118 p refs
(Contract NAS2-5482)
(NASA-CR-114687; R73AEG306) Avail: NTIS HC \$9.00 CSCL 01C

An analytical study of fly-over noise using noise contours to show the effects of varying airplane and path parameters. The method of approach was to synthesize engine component noise spectra and exercise these components along given flight paths to measure the individual and total fly-over effect as a function of noise footprint area. The study was carried out in two phases. Phase 1 utilized a research type aircraft and Phase 2 used an advanced VTOL aircraft. The effect of cross flow was considered for both inlet and exhaust sections of the engine. Author

N74-20668*# Scientific Translation Service, Santa Barbara, Calif.

THE Do 31 LANDING LOADS DURING VERTICAL LANDING AND THEIR CONSEQUENCES FOR FUTURE V/STOL DEVELOPMENTS

W. Schoernack Washington NASA Apr. 1974 55 p refs Transl. into ENGLISH of "Die Landelasten der Do 31 bei Vertikallandungen und Folgerungen fuer zukuenftige VSTOL Entwicklungen". West Germany, report BMVG-FBWT-72-24, 1972 72 p

(Contract NASw-2483)
(NASA-TT-F-15532; BMVG-FBWT-72-24) Avail: NTIS HC \$5.75 CSCL 01C

The results of 83 vertical landings carried out during the Do 31 V/STOL experimental program are presented. In 23 landings undercarriage reactions as well as sinking speeds were measured, of the remaining 60 landings only sinking speeds could be evaluated. Undercarriage reaction factors and sinking speeds are plotted as frequency distributions and are discussed. The result of the evaluation of the landing experiments can be summarized as follows: VTOL airplanes having a similar concept as the Do 31 and using manual control during the end of descent would experience considerably higher sinking speeds than conventional aircraft. The frequency distribution of the sinking speeds is very severe and sinking speeds below 1 m/sec do not occur.

Author

N74-20669*# Kanner (Leo) Associates, Redwood City, Calif. RESULTS AND INFORMATION OBTAINED REGARDING AERODYNAMIC JET INTERFERENCE ASSOCIATED WITH THE Do 31 V/STOL JET TRANSPORT AIRCRAFT AND THEIR APPLICATION TO FUTURE V/STOL DEVELOPMENT

D. Welte Washington NASA Apr. 1974 146 p Transl. into ENGLISH of "Ergebnisse und Erfahrungen zur aerodynamischen Strahlinterferenz beim VSTOL-Strahltransportflugzeug Do 31 und ihre Anwendung auf zukuenftige VSTOL-Entwicklungen", Dornier-Werke G.m.b.H., Friedrichshafen, West Germany, Report BMVG-FBWT-72-22, 1972 183 p

(Contract NASw-2481)
(NASA-TT-F-15533; BMVG-FBWT-72-22) Avail: NTIS HC \$10.50 CSCL 01C

The most important results concerning jet interference effects for the Do 31 aircraft, resulting from wind tunnel model measurements and flight tests, are presented, and an estimation is given of jet interference effects for future V/STOL project studies. Calculations are based, on a single semi-empirical method for determination of jet induced lift loss in hovering for simple configurations such as the Do 31, and it is possible to calculate the lift loss to within 1% accuracy. The investigation of the jet induced flow field around the Do 31 during hovering with ground effect and in the transition flight regime yielded a rough estimation of the jet interference effects for future V/STOL studies.

Author

N74-20670# Joint Publications Research Service, Arlington, Va.

USE OF THE METHOD OF VARIATION OF SIMILARITY CONSTANTS IN DESIGNING AIRCRAFT OVER THE LONG TERM

R. I. Vinogradov 7 May 1974 10 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Aviats. Tekhn. (Kazan), no. 4, 1966 p 68-74

(JPRS-61923) Avail: NTIS HC \$4.00

The use of the method of variation of similarity constants is discussed. Mechanical models with complex boundary conditions are used as computing devices. Transformation to various full scale systems is achieved by math modelling.

Author

N74-20672*# Boeing Commercial Airplane Co., Seattle, Wash. CRUISE DRAG RESULTS FROM HIGH SPEED WIND TUNNEL TESTS OF NASA REFAN JT8D ENGINE NACELLES ON THE BOEING 727-200

W. G. Easterbrook and R. B. Carlson Dec. 1973 42 p (Contract NAS3-17842)

(NASA-CR-134546; D6-43099) Avail: NTIS HC \$5.25 CSCL

01C

High speed wind tunnel test results are presented showing the cruise drag effect of installing JT8D-109 refan engines on a Boeing 727-200. Incremental drags of a refan center inlet and side nacelles are presented for several configuration variations. Static pressure distributions were obtained on the side nacelle strut and on the fuselage (above and below the strut). Oil flow photographs of selected configurations are also presented. In general the drag level of the refan installation is slightly better than predicted prior to the test and the drag rise is favorable.

Author

N74-20673# Institut Franco-Allemand de Recherches, St. Louis (France).

CALCULATION OF THE GEOMETRICAL PROPAGATION OF THE SONIC BOOM ALONG THE FLIGHT PATH ON THE GROUND UNDER REAL ATMOSPHERIC CONDITIONS WITH WIND [CALCUL DE LA PROPAGATION GEOMETRIQUE DU BANG SOUS TRACE DANS LE CAS D'ATMOSPHERES REELLES AVEC VENT]

M. Schaffar, C. Thery, and F. Schlosser 19 Dec. 1972 87 p refs In FRENCH

(Contract DRME-72/337)
(ISL-37/72) Avail: NTIS HC \$7.50

The influence of real atmospheric conditions such as wind and temperature on the ground position of sonic boom carpet created by supersonic flight was investigated using programs for computation of acoustical propagations taking into account the meteorological parameters and examining longitudinal focalization and extinction points. The computation shows that the boom propagation distances along the aircraft axis trajectory are functions of the longitudinal component of the wind for the Mach number equal to 1. This distance for the extinction ray can reach three times the standard distance in backward wind conditions and half the standard distance in forward wind conditions. The horizontal ray trajectories leading to the focalization are varying with meteorological conditions. The incertitude on the boom carpet positions seems due to the imprecision on meteorological sounding and to the variation of atmospheric conditions between two successive soundings.

ESRO

N74-20675# European Space Research Organization, Paris (France).

DETERMINATION OF THE DERIVATIVES OF LONGITUDINAL MOTION OF AN AIRCRAFT FROM FLIGHT DATA BY A MODEL WITH AUTOMATIC PARAMETER ADJUSTMENT

R. Koehler Jan. 1974 44 p refs Transl. into ENGLISH of Bestimmung von Derivativen der Laengsbewegung eines Flugzeugs aus Flugmessdaten durch ein Modell mit Autom. Parametereinstellung. DLR-FB-73-13, DFVLR, Nov. 1972 (ESRO-TT-8; DLR-FB-73-13) Avail: NTIS HC \$5.25; DEVL R Porz-Wahn: 10 DM

A circuit was used to determine the aircraft derivatives from flight data; this circuit needs relatively few computation elements from the analog computer. Since quadratic terms are used, the polar data can be determined from environment coefficients of a point.

Author (ESRO)

N74-20676# Joint Technical Coordinating Group for Air Launched Non-Nuclear Ordnance.

AIRCRAFT/STORES COMPATIBILITY SYMPOSIUM PROCEEDINGS, VOLUME 2

20 Sep. 1973 249 p refs Conf. held at Sacramento, Calif., 18-20 Sep. 1973 3 Vol. (AD-773814; JTCG/ALNNO-WP-12-2-Vol-2) Avail: NTIS CSCL 01/3

Contents: Self-compensating store ejection; Naval missile center photo data analysis of store-separation films; Low speed wind tunnel testing techniques to predict S-3A aircraft store drop and jettison characteristics; Extensions to the method for prediction of six-degree-of-freedom store separation trajectories at speeds up to the critical speed, including interactive graphics application and bodies of arbitrary cross section; Computer generated visual documentation of theoretical store separation

analyses; A pivot mechanism to provide an extended jettison envelope for the F-15 aircraft. GRA

N74-20677# Mississippi State Univ., State College. Dept. of Aerophysics and Aerospace Engineering.
AN INVESTIGATION OF THE TRAILING VORTICITY BEHIND A STOL AIRCRAFT Final Report, Sep. 1971 - Aug. 1973
 Lawrence J. Mertaugh and Ruston B. Damania Dec. 1973
 109 p refs
 (Contract F33615-72-C-1052; AF Proj. 1366)
 (AD-774571; AASE-73-107; AFFDL-TR-73-138) Avail: NTIS CSCL 01/1

The report presents the results of a test program to measure the near-field wake behind the wing of a test aircraft, out of the ground effect, and to obtain vortex trajectory data on trailing vortices generated within the ground effect. The test aircraft was a high-lift L-19 aircraft incorporating a distributed-suction boundary layer control system. The wake measurement probe was supported from the fuselage of the test aircraft and was mounted on a trolley which moved along a boom structure. The velocity measurements were made with a six-element hot-film anemometer. The near field wake data were obtained in two measurement planes located 0.64 and 5.10 feet behind the wing. Data were obtained at zero and full flap deflection and true speeds of 46, 66, and 85 mph. The data are presented as contours of constant normalized vorticity, nondimensional vertical velocity, and non-dimensional longitudinal velocity increment within the measurement planes. (Modified author abstract) GRA

N74-20678# Calspan Corp., Buffalo, N.Y.
FLIGHT INVESTIGATION OF LATERAL-DIRECTIONAL FLYING QUALITIES AND CONTROL POWER REQUIREMENTS FOR STOL LANDING APPROACH USING THE X-22A AIRCRAFT. VOLUME 1: TECHNICAL RESULTS Final Report
 R. E. Smith, J. V. Lebacqz, and R. C. Radford Feb. 1974
 117 p refs
 (Contract N00019-72-C-0417)
 (AD-774728; CALSPAN-AK-5130-F-1-Vol-1) Avail: NTIS CSCL 01/2

A flight investigation of the influence of lateral-directional dynamics and control power requirements on flying qualities for STOL aircraft in terminal area operations was conducted using the X-22A variable stability aircraft. The primary dynamic variables of the experiment were roll mode time constant, Dutch roll undamped natural frequency, roll-to-sideslip ratio, and yaw due to aileron; in addition, the roll control power available was varied by electrically limiting the lateral stick command of the evaluation pilot. Three pilots performed 102 evaluations of various combinations of these variables at a representative STOL approach condition of $\gamma = -7.5$ degrees, $V = 65$ kts. During the evaluations, a qualitative separation of ambient turbulence level was made through approximate measurements from the aircraft. (Modified author abstract) GRA

N74-20679# Calspan Corp., Buffalo, N.Y.
FLIGHT INVESTIGATION OF LATERAL-DIRECTIONAL FLYING QUALITIES AND CONTROL POWER REQUIREMENTS FOR STOL LANDING APPROACH USING THE X-22A AIRCRAFT. VOLUME 2: BACKGROUND INFORMATION Final Report
 R. E. Smith, J. V. Lebacqz, and R. C. Radford Feb. 1974
 314 p refs
 (Contract N00019-72-C-0417)
 (AD-774729; CALSPAN-AK-5130-F-1-Vol-2) Avail: NTIS CSCL 01/2

For abstract, see N74-20678.

N74-20680# Calspan Corp., Buffalo, N.Y.
A FIXED-BASE GROUND SIMULATOR STUDY OF CONTROL AND DISPLAY REQUIREMENTS FOR VTOL INSTRUMENT LANDINGS WITH A DECELERATING APPROACH TO A HOVER Final Report
 Edwin W. Aiken and John M. Schuler Feb. 1974 97 p refs

(Contract N00019-72-C-0380)
 (AD-774750; CALSPAN-AK-5113-F-2) Avail: NTIS CSCL 01/2

An exploratory study of the control and display requirements for performing decelerating transition landings on instruments with the X-22A aircraft was conducted utilizing the X-22A fixed-base ground simulator as a test bed. This experiment was prerequisite for an in-flight VTOL Transition Landing Program using the variable stability X-22A as a research vehicle. Both full and partial transitions to a hover were flown along a 10 degrees glide path at deceleration levels of up to 0.1 g. Various control/display system combinations were designed, developed, and evaluated for the task. Two specific objectives of the experiment were to investigate the benefits of a direct velocity control system, as opposed to the normal X-22A thrust controls, and to determine the feasibility of adapting, through electronic rather than mechanical means, the X-22A duct rotation system to direct velocity control. (Modified author abstract) GRA

N74-20681# RAND Corp., Santa Monica, Calif.
A DASSAULT DOSSIER: AIRCRAFT ACQUISITION IN FRANCE
 Robert Perry Sep. 1973 42 p refs Sponsored by AF
 (AD-774598; R-1148-PR) Avail: NTIS CSCL 01/3

The report is concerned with Avions Marcel Dassault-Breguet, generally held to be one of the most efficient aircraft development and production firms in the western world. Its purpose is to examine and evaluate the policies, strategies, operating practices, and external relationships that appear to be responsible for that reputation and for the achievements that underlie it. A principal object of the study is to identify those Dassault attributes that might beneficially be adapted to an American setting and to estimate the feasibility of so doing. GRA

N74-20682# Albuquerque Univ., N.Mex.
FALCONRY AS A MEANS OF REDUCING BIRD-AIRCRAFT STRIKE HAZARDS AT WHITEMAN AIR FORCE BASE, MISSOURI Final Report, 15 Sep. 1972 - 22 Apr. 1973
 Edwin Mattingly Jan. 1974 40 p refs
 (Contract F29601-73-C-0100; AF Proj. 683L)
 (AD-774568; AFWL-TR-73-175) Avail: NTIS CSCL 01/2

A serious bird-aircraft strike hazard exists at Whiteman AFB (WAFB), Mo., because of the resident flock of protected Greater Prairie Chickens (*Tympanuchus cupido pinnatus*) which may be found on and near the runways. In recent years an increasing traffic load, involving mostly jet aircraft, frequently with highly sensitive cargo, has raised the strike hazard to intolerable limits. During the last 5 years, a minimum of 12 bird-aircraft strikes were recorded each spring. After almost all conventional methods of bird control has been tried with only partial or temporary success, a program of continual harassment using combinations of men, dogs, and falconry proved the most effective in the spring of 1973. Two air strikes were experienced early in the test program and none after that. By techniques described herein, the strike hazard at WAFB was reduced by at least 83.3%. Author (GRA)

N74-20683# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
AIR CUSHION LANDING SYSTEM PERFORMANCE ON A TENTH-SCALE MODEL JINDIVIK RPV M.S. Thesis
 Philip M. Parker, Jr. Nov. 1973 74 p refs
 (AD-774389; GAM/AE/73A-15) Avail: NTIS CSCL 01/3

Tests were conducted on an air cushion landing system ACLS installed on a tenth-scale model Jindivik RPV. The model has the correct Froude-scaled values of weight, center of gravity cg and moment of inertia about all three axes. The results of these tests were compared to the results of similar tests conducted on the ACLS of a full-scale model Jindivik. Static tests on the tenth-scale ACLS determined the heave stiffness to be 11 lb per in., the pitch stiffness to be .155 lb ft per deg (for a nose down moment) and the roll stiffness to be .0048 lb ft per deg. These values were within 60% of the full-scale values. Drop tests showed the maximum load at the cg of the model to vary

between 2.2 g's at the scaled nominal landing rate of descent, to 5.4 g's at the maximum landing rate of descent. (Modified author abstract) GRA

N74-20684# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

AN EXPERIMENTAL STUDY OF THE EFFECT OF A LOW SPEED EXTERNAL FLOW ON A COANDA EFFECT FLAP M.S. Thesis

Henry G. Hamby, III Dec. 1973 65 p refs
(AD-774393; GAM/AE/73A-9) Avail: NTIS CSCL 01/3

An experimental study of the effect of a low speed air flow external to the blowing flow over a coanda effect flap was conducted. The test model had a 122 ft/sec external flow over an airfoil surface which terminated with a coanda effect flap. The flap had an internal flow velocity of 452 ft/sec at the coanda nozzle exit. The model was equipped to make possible vertical force measurements and schlieren photography of the flap area. The force measurements showed that the net vertical force produced by the combined internal and external flows was equal to the net vertical force of the individual flows. (Modified author abstract) GRA

N74-20685# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

AN EXPERIMENTALLY BASED PREDICTION OF THE STATIC PERFORMANCE IN THE VERTICAL DIRECTION OF AN AIR CUSHION LANDING SYSTEM M.S. Thesis

John L. Stuart Dec. 1973 56 p refs
(AD-774387; GAM/AE/73A-17) Avail: NTIS CSCL 01/3

The purpose of the study was to develop an analytical procedure which can be used to predict the static performance of an Air Cushion Landing System in the vertical direction. A mathematical model of an ACLS was developed which interrelates the system variables used to describe the force balance, the flow balance, and the geometric constraints which exist in the static mode. Since the mathematical model yielded only nine equations in thirteen unknowns, four additional equations were generated from experimental data taken from scale models of an ACLS-equipped CC-115 aircraft. Experimental values of trunk pressure, cushion pressure, and ground clearance at different gross weights for both floor-in and floor-out conditions are required as inputs to the prediction procedure. (Modified author abstract) GRA

N74-20686# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

STATIC TWO DIMENSIONAL PERFORMANCE OF A CUSHION FED AIR CUSHION LANDING SYSTEM M.S. Thesis

Eduardo M. Carreras Dec. 1973 76 p refs
(AD-774394; GAW/AE/74-1) Avail: NTIS CSCL 01/3

Tests were conducted on a two dimensional model of the trunk region of an air cushion landing system to determine the performance under different flow conditions. The purpose of these tests was to evaluate the effect of the trunk to cushion flow ratio, the cushion to trunk pressure ratio, the flow injection angle and the ratio of the escape area to the nozzle area. Performance was characterized by the ratio of the horsepower required to the horsepower required by an ideal plenum air cushion device under the same conditions. (Modified author abstract) GRA

N74-20688# Calspan Corp., Buffalo, N.Y.
A REVIEW OF THE X-22A VARIABLE STABILITY AIRCRAFT AND RESEARCH FACILITY Final Report

J. Victor Labaco, Rogers E. Smith, and Robert C. Radford Feb. 1974 98 p refs

(Contract N00019-72-C-0417)
(AD-774142; CALSPAN-AK-5130-F-2) Avail: NTIS CSCL 01/3

The variable stability X-22A aircraft and associated research facilities represent a unique capability to perform V/STOL flying qualities research. The demonstrated fix-operating point capabilities

ties of the aircraft's variable stability system are reviewed, and the recent extension of these capabilities for hover and transition is documented in detail. The report also contains summary descriptions of the ground simulator facility, the X-22A aircraft systems, and data processing and analysis procedures.

Author (GRA)

N74-20689# United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft Div.

A DESIGN ANALYSIS OF CH-54B MAIN ROTOR HUB FABRICATED FROM COMPOSITE MATERIALS Final Technical Report

Robert Lee Faiz Oct. 1973 228 p refs
(Contract DAAJ02-72-C-0104; DA Proj. 1F1-62208-A-170)
(AD-774270; SER-50827; USAAMRD-TR-73-49) Avail: NTIS CSCL 01/3

A design and structural analysis of a CH-54B main rotor hub fabricated from composite materials was made to assess the flightworthiness of a hub consisting basically of tension straps fabricated from graphite epoxy and fiberglass. The concept is feasible but not competitive with the production titanium hub from a weight standpoint. Author (GRA)

N74-20690# Army Air Mobility Research and Development Lab., Fort Eustis, Va.

EFFECTS OF HELICOPTER EXTERNAL LOADS ON SLING PROPERTIES Final Report

Arthur J. Gustafson, Jr., Max E. Bryan, Edgar H. McIlwain, and Eugene A. Birocco Sep. 1973 85 p refs
(DA Proj. 1F1-62203-A-435)
(AD-774267; USAAMRD-TR-73-91) Avail: NTIS CSCL 01/3

Samples of webbing of the type currently used for slings to carry external cargo by Army helicopters were tested to determine which environmental factors contributed to premature failure of the webbing. The environmental factors included outdoor exposure, temperature, humidity, JP-4 and seawater immersion, sand, and vibratory loading. Several types of nylon and Dacron were tested. The results of these tests indicate that outdoor exposure has a major effect on webbing strength. The presence of sand between the yarns in the webbing produces early failure. Shackle FSN 1670-090-5354 causes severe damage to slings under vibratory loading if used without a protective pad. Temperature, humidity, fuel and seawater immersion, and indoor storage have a negligible effect on webbing strength. Author (GRA)

N74-20691# Bell Aerospace Co., Buffalo, N.Y.
JET NOISE REDUCTION TECHNIQUE FOR MILITARY RECONNAISSANCE/SURVEILLANCE AIRCRAFT. PHASE 1: BENCH/WIND TUNNEL TESTS Final Report.

30 Jun. 1971 - 31 Jul. 1972
F. B. Bossler, M. V. Barsottelli, and V. Krishnamoorthy Aug. 1973 150 p refs
(Contract F33615-71-C-1840; AF Proj. 1471)
(AD-774748; BAC-7389-945009; AFFDL-TR-72-107) Avail: NTIS CSCL 01/3

A novel method of jet noise reduction has been subjected to bench and wind tunnel tests. This method uses very small nozzles arranged on struts protruding from the upper surface of an aircraft wing. These nozzles are intended to replace the conventional single propulsive nozzle of the jet engine for the primary purpose of reducing the aural detectability of the jet noise by modifying its frequency spectrum. Tests of this concept were conducted during this program including acoustic comparison of a dozen different nozzle arrangements; tests with heated air; acoustic and propulsion tests of an array of several thousand nozzles; acoustic wind tunnel tests of struts and inlet configurations; and aerodynamic wind tunnel tests of an array of 6,000 nozzles on a wing section. Additional tasks included preliminary design of a quiet research test vehicle and prediction of its aural detectability. Tests of various nozzle arrangements resulted in selection of a single row of nozzles on each strut. Tests with heated air showed that jet noise could be predicted based on jet velocity, independent of jet temperature. (Modified Author abstract) GRA

N74-20692# Naval Air Development Center, Warminster, Pa. Air Vehicle Technology Dept.

TEST PLAN FOR THE HOOK BOUNCE CONDITION OF THE E-2A AIRPLANE ARRESTING GEAR A FRAME Test Plan Report

Robert B. Cadman 30 Nov. 1973 8 p refs Revised (AD-774084; NADC-72216-VT-Rev-A) Avail: NTIS CSCL 01/5

The E-2A arresting hook A-frame is currently adequate for 500 arrested landings. It is the purpose of this effort to extend the life to 3,000 arrested landings for the hook bounce condition. Author (GRA)

N74-20693# Naval Air Development Center, Warminster, Pa. Air Vehicle Technology Dept.

TEST PLAN FOR THE HOOK BOUNCE CONDITION OF THE C-2A AIRPLANE ARRESTING GEAR A FRAME Test Plan Report

1 May 1973 10 p refs Revised (AD-774083; NADC-72178-VT-Rev-A) Avail: NTIS CSCL 01/5

The C-2A arresting hook A-frame is currently adequate for 500 arrested landings. It is the purpose of this effort to extend the life to 3000 arrested landings for the hook bounce condition. Author (GRA)

N74-20694# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

ADDITION OF AN ARBITRARY BODY ANALYSIS CAPABILITY TO THE BOEING TEA 236 FINITE ELEMENT COMPUTER PROGRAM M.S. Thesis

James L. Westphal Dec. 1973 91 p refs (AD-774430; GAM/AE/73A-20) Avail: NTIS CSCL 01/3

The Boeing TEA 236 computer program, used to calculate wing pressure distributions of wing-body configurations, is examined. Small perturbation potential theory, as used by the program, is reviewed. The method used by the TEA 236 in the analysis of a fuselage of circular cross-section, in calculating wing pressures, is examined. The capability to analyze an arbitrary body cross-section is added by employing at least-squares fitted cosine series to more accurately describe the actual body cross-section. Comparison is made between C-5A wind tunnel data, computed data obtained from the TEA 236 using its unmodified circular body routine, and computed data obtained from the TEA 236 using the analytical body description technique developed in this study. (Modified author abstract) GRA

N74-20696# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

AN ANALYSIS OF THE LONGITUDINAL DYNAMICS OF A STOL TRANSPORT IN LANDING APPROACH M.S. Thesis

Glen M. Personius Dec. 1973 83 p refs (AD-774434; GAM/MC/73A-1) Avail: NTIS CSCL 01/2

The longitudinal dynamic response of representative STOL transport in landing approach was analyzed and the results compared with existing military handling qualities specifications. Eigenvalues and eigenvectors for the basic airplane were calculated using EISPACK subroutines for the CDC-6600 computer. Time histories of response were obtained by using series expansion techniques to solve the state equations. The parameter, μ , change in pitching moment with change in forward speed, was found to have a powerful effect on both static and dynamic stability. Low short period frequency and negative phugoid damping in the landing approach speed range, combined with strong coupling between flight path and airspeed, make the basic airplane longitudinal dynamics unacceptable. Some suggestions are made relative to the preliminary design of a stability augmentation system for this airplane. Author (GRA)

N74-20763 Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.

OPERATIONAL PRACTICALITY OF FLY AWAY EJECTION SEATS

R. Harley Walker, Jr. In AGARD Escape Probl. and Manoeuvres in Combat Aircraft Feb. 1974 15 p refs

N74-20766 Naval Air Development Center, Warminster, Pa. Crew Systems Dept.

ADVANCED CONCEPTS FOR ROTARY WING AND V/STOL AIRCRAFT ESCAPE SYSTEMS

William G. Law In AGARD Escape Probl. and Manoeuvres in Combat Aircraft Feb. 1974 5 p refs

N74-20770 Institut fuer Flugmechanik, Brunswick (West Germany).

ESCAPE MEASURES FOR COMBAT HELICOPTER CREWS

H. D. Melzig and U. Schmidt In AGARD Escape Probl. and Manoeuvres in Combat Aircraft Feb. 1974 11 p refs

N74-20771 Army Aeromedical Research Lab., Fort Rucker, Ala.

ARMY AUTOROTATIONAL ACCIDENTS

Kent A. Kimball, Donald F. Harden, and Mark A. Hofmann In AGARD Escape Probl. and Manoeuvres in Combat aircraft Feb. 1974 10 p

A study reviewing autorotation accidents was initiated to ascertain the relative contributions that certain factors had in such accidents. The active Army, for fiscal years 1970 through 1972, was reviewed and a total of 790 accidents, or 42.3% of all accidents, were of the autorotational type. They accounted for over 89 million dollars in aircraft damage, 92 aircrew fatalities and 652 aircrew injuries. Of these 790 accidents, it was determined that personnel error alone accounted for 32.7% of the accidents, while material failure alone accounted for 31.4%. Of the remaining accidents (35.9%), 20.9% were attributed to a combination of personnel error and material failure, while the remaining 15% were attributed to other causative factors. Though the total number and rate of rotary wing accidents was found to be declining over the time for frame considered, the number of autorotation accidents attributed solely to personnel error was found to be on the increase, with fiscal year 1972 approximately 10% higher than 1970. The study also reviews autorotation accidents in light of total accidents, rates, geographical areas, aircraft, cost, fatalities, and injuries. It also provides impact data with regard to the reduction of certain parameters. Author

N74-20772 Naval Air Development Center, Warminster, Pa. **IN-FLIGHT ESCAPE SYSTEM FOR HEAVY HELICOPTERS**

William Ogden and Gary Davis (Naval Air Systems Command) In AGARD Escape Probl. and Manoeuvres in Combat Aircraft Feb. 1974 9 p refs

The design and development of a helicopter escape and personnel survival system (HEPS) are discussed. The system contains four primary functions: (1) in flight escape, (2) crash impact energy attenuation, (3) fuel fire suppression, and (4) flotation. The configuration of the system is illustrated. Results of flight tests are reported. Author

N74-20819# European Space Research Organization, Paris (France).

POSSIBILITIES OF AN AIRBORNE TELEVISION SYSTEM

Armin Quast Feb. 1974 28 p refs Transl. into ENGLISH of "Moenlichkeiten eines Flugzeug-Fernseh-Systems", DFVLR, Inst. fuer Aerodyn., Brunswick, report DLR-MITT-73-09, 1973 (ESRO-TT-20; DLR-MITT-73-09) Avail: NTIS HC\$4.50; DFVLR Porz-Wahn: 8.50 DM

At present television is transmitted nearly exclusively via ground stations and for the future transmission by satellite is taken into consideration. An airborne television system is considered, which has remarkable technical and economical advantages. It is shown that two aircraft circulating at an altitude of 20 km can replace the whole ground system of an area with the dimension of the Federal Republic of Germany. The airborne television system can be realized without technical risks and at relatively low cost. The aircraft itself can be used for numerous future tasks. Author (ESRO)

N74-20904# New Mexico Univ., Albuquerque. Eric H. Wang
Civil Engineering Research Facility.

AIRFIELD EROSION CONTROL FOR C-5A AIRCRAFT OPERATIONS Final Report, May - Jul. 1971

Robert O. Clark, Rey A. Shunk, Wayne M. McMurty, and Richard A. Weismiller Jan. 1974 30 p refs
(Contract F29601-72-C-0024; AF Proj. 683M)

(AD-774484; AFWL-TR-73-139) Avail: NTIS CSCL 01/5

A study was conducted to map the surface velocity contours of the air movement and engine exhaust produced by the C-5A aircraft during takeoff roll and rotation. This study was undertaken to determine possible causes of runway shoulder erosion. Windscreens and smoke grenades were to determine the directional nature of the surface air movement and engine exhaust. These data were then used to determine placement of Pitot probes to measure air velocity forces. Pitot probes and static pressure gages, containing strain-type electronic sensors, were placed along two parallel lines extending from 50 to 150 ft perpendicular to the centerline of the aircraft roll path. The entire takeoff roll was studied by conducting repeated test runs in which the aircraft breakaway point was progressively moved closer, in 1000-ft increments, to the instrumentation. (Modified author abstract)

GRA

N74-20905# Naval Training Equipment Center, Orlando, Fla.
DYNAMICS REPORT FOR T-28B SIMPLIFIED FLIGHT SIMULATOR Final Report, 1965 - 1970

Moses Anson Mar. 1973 68 p refs

(AD-774479; NAVTRAQUIPC-IH-217) Avail: NTIS CSCL 01/3

A study was conducted to develop a method and approach by which specific characteristics of the NAA T-28B aircraft are to be simulated. This includes also the aerodynamic design data developed and needed for computer programming; aircraft equations of motion and position; simulator equations of motion and position; simulator instrument, aircraft systems, flight control and engine equations; definition of symbols, subscripts, and mathematical notation; aerodynamic coefficients and their data source; cockpit layout; and control feel design. The mathematical models for the T-28B aircraft developed under this study are applicable at a fixed gross weight of 7700 lbs and 25% c.g. location. A simplified solution for the throttle movement versus thrust horsepower output relationship was also developed. (Modified author abstract)

GRA

N74-20907# Calspan Corp., Buffalo, N.Y.
IN-FLIGHT TESTING OF A FLIGHT CONTROL MULTIPLEX SYSTEM IN THE NC-131 H TOTAL IN-FLIGHT SIMULATOR Final Report, 10 Jul. - 15 Dec. 1972

James N. Dittenhauser, G. J. Fabian, and Arno E. Schelhorn Mar. 1973 112 p refs

(Contract F33615-72-C-1183; AF PROJ. 8225)

(AD-774049; CALSPAN-AK-5174-F-1; AFFDL-TR-73-11) Avail: NTIS CSCL 01/3

An in-flight evaluation has been made of the effect of inserting a multiplexing device into the fly-by-wire control system of an airplane. The multiplex system was successfully used to transmit control signals in the AFFDL TIFS airplane when operating in a fly-by-wire mode. The basic characteristics which were examined are externally generated electrical noise effect of sampling rates and resolution as well as noise from the multiplex equipment itself. The data results consist of pilot evaluations and comparison of records of the flight control system performance and aircraft response with and without the multiplex units being used to transmit the signals. In addition, records of the signals entering and leaving the multiplex equipment were available for comparison so that the specific effects of insertion of the multiplex system could be identified. (Modified author abstract)

GRA

N74-21022# Joint Publications Research Service, Arlington, Va.

MAGNETOMETERS

2 Apr. 1974 36 p refs Transl. into ENGLISH from Geofiz. App. (Leningrad), no. 44, 1970 29 p
(JPRS-61636) Avail: NTIS HC \$5.00

Various types and designs of magnetometers are described, including rubidium, towed, quantum, and T-airborne magnetometers. The component reliability and accuracy are also considered. For individual titles, see N74-21023 through N74-21028.

N74-21026 Joint Publications Research Service, Arlington, Va.
PECULIARITIES IN OPERATION OF THE ORIENTING SYSTEM FOR A T-AIRBORNE MAGNETOMETER

A. I. Tarayev and V. L. Kantorovich In its Magnetometers (JPRS-61636) 2 Apr. 1974 p 20-25 refs Transl. into ENGLISH from Geofiz. App. (Leningrad), no. 44, 1970 p 37-40

Provision was made for a fixed setting of the fork of the outer suspension in the universal joint of a T-airborne magnetometer. The design and planning of the OSS for a magnetometer was carried out, based on values of maximum perturbations with respect to course, banking, and pitching angles. J.A.M.

N74-21027 Joint Publications Research Service, Arlington, Va.
CONSTRUCTION OF DIFFERENTIATING DEVICES FOR AN AIRBORNE MAGNETOMETER

S. S. Vander In its Magnetometers (JPRS-61636) 2 Apr. 1974 p 26-29 refs Transl. into ENGLISH from Geofiz. App. (Leningrad), no. 44, 1970 p 131-133

Measurement errors of magnetic field strength were reduced by combining a magnetic sensitive unit with a Doppler navigation system; thereby ensuring constant quantizing intervals in distance. Algorithms for operating two types of differentiating devices are identical. J.A.M.

N74-21028 Joint Publications Research Service, Arlington, Va.
DETERMINING THE ACCURACY IN REGISTRY BY HIGHLY SENSITIVE AIRBORNE MAGNETOMETERS

L. N. Kotlyarevskiy In its Magnetometers (JPRS-61636) 2 Apr. 1974 p 30-33 refs Transl. into ENGLISH from Geofiz. App. (Leningrad), no. 44, 1970 p 173-175

The accuracy of an airborne magnetometer survey was determined from computational results of the mean square difference between the Delta T curves. These curves were registered on the same flight path on different days or with different instruments. Another method for determining magnetometer accuracy was proposed, comparing the cross sections of reflections. J.A.M.

N74-21042# European Space Research Organization, Paris (France).

COMPARISON OF CONVENTIONAL AND ELECTRONIC INDICATOR INSTRUMENTS IN A FLIGHT SIMULATOR AND IN A TEST AIRCRAFT

H.-D. Schenk et al Jan. 1974 60 p refs Transl. into ENGLISH of Vergleich von konventionellem und Elektron. Anzeigegeraet im Flug Simulator und Versuchsflugzeug. DLR-FB-73-44. DFVLR, 1973

(ESRO-TT-13; DLR-FB-73-44) Avail: NTIS HC \$6.00; DFVLR Porz-Wahn: 12.50 DM

Extensive in-flight and simulator tests supplemented by tachistoscopic investigations were carried out to compare an experimental electronic attitude director indicator with conventional flight instruments and with a modern integrated flight director. The results show that the operational qualities of the CRT-display system at least equal those of the integrated instrument. Full use of the system flexibility of the electronic display unit is expected to bring further advantages under various operating conditions. Author (ESRO)

N74-21044# European Space Research Organization, Paris (France).

COMPARATIVE SIMULATOR STUDIES WITH THE CONTACT ANALOG CHANNEL DISPLAY AND WITH CONVENTIONAL INSTRUMENTS

Wolfram Schattenmann et al Feb. 1974 47 p refs Transl. into ENGLISH of "Vergleichende Simulatorstudien mit dem Kontaktanalogen Kanaldisplay und mit konventionellen Instrumentierungen," DLR-FB-73-57, DFVLR, 1973

(ESRO-TT-15; DLR-FB-73-57) Avail: NTIS HC \$5.50; DFVLR Porz-Wahn: 13.30 DM

Tests were conducted to determine if the channel display device allows similar guidance precision as that obtained with the flight director. The device is compared in simulator tests with standard instrument landing systems, accumulated instrument landing systems, and the flight director. The results show that the channel display offers superior guidance precision compared with instrument landing systems and equivalent precision compared with an optimized flight director. An analysis of the motion and control variables shows that the control technique of the pilot depends strongly on how the information is presented. Flying with the channel display. The pilot uses the controls in the same manner as under visual flight conditions, enabling a continuous transition from instrument flight rules to visual flight rules and oppositely. Author (ESRO)

N74-21047# Conrac Corp., Duarte, Calif.

HIGH TEMPERATURE SOLID STATE PRESSURE TRANSDUCERS FOR MILITARY JET ENGINE ENVIRONMENTS Final Technical Report, Mar. 1972 - Oct. 1973

Gerald L. Vick and J. H. House Oct. 1973 36 p refs (Contract F33615-72-C-1179; AF Proj. 1987)

(AD-774753; AFFDL-TR-73-145) Avail: NTIS CSCL 14/2

The document reports the work performed to apply advance design and fabrication techniques to the economic development of high temperature solid state pressure transducers for military jet engine environments. Improvements in a previously developed high temperature solid state pressure transducer have been made in a number of areas. Media compatibility has been extended from clean air to conductive and mildly corrosive liquids and gases. Cost effective reductions to warrant production have been achieved. Accuracy has been improved by introduction of nonlinear temperature compensation. The operating temperature range has been extended from 660F to 750F with survival proven to 930F. Author (GRA)

N74-21049# Hughes Aircraft Co., Culver City, Calif. Display Systems and Human Factors Dept.

DEVELOPMENT OF DESIGN CRITERIA FOR SENSOR DISPLAYS Annual Report, May - Dec. 1973

James G. Rogers and Walter L. Carel Dec. 1973 128 p refs (Contract N00014-72-C-0451; NR Proj. 213-107)

(AD-774725; HAC-Ref-C6619) Avail: NTIS CSCL 05/8

The program objective is: To conduct applied research using analytical and experimental investigations for identifying, defining and validating advanced concepts which may be applied to future, improved Naval and Army aircraft instrumentation systems. This includes sensing elements, data processors, displays, controls and man/machine interfaces for fixed and rotary wing aircraft for all flight regimes. The following topics are treated in the report: Psychophysical studies, modulation sensitivity function; cognitive demand studies; and analysis of display mechanization performance criteria. GRA

N74-21080# European Space Research Organization, Paris (France).

SPECTROSCOPIC ANALYSIS OF WEAR METALS BASED ON THE EXAMINATION OF OIL FROM AIRCRAFT ENGINES

Eilhard Jantzen Feb. 1974 53 p refs Transl. into ENGLISH of "Ueber die spektroskopische Analyse von Metallabries anhand von Oeluntersuchungen aus Flugtriebwerken", DFVLR, Inst. fuer Flugtrieb- und Schmierstoffe, Munich, report DLR-FB-73-06.

1973

(ESRO-TT-23; DLR-FB-73-06) Avail: NTIS HC \$5.75

Tests were made using these spectroscopic methods on oil from JT3D engines. In addition, all oil samples were tested for light transmittance in the visible region of the spectrum. This can be used to detect oil changes and topping up. The size and shape of wear metals in JT3D aircraft engines were established by a scanning electron microscope. Author (ESRO)

N74-21084# Aeroprojects, Inc., West Chester, Pa. **ENGINEERING FEASIBILITY STUDY OF ULTRASONIC APPLICATIONS FOR AIRCRAFT MANUFACTURE** Final Report

Florence R. Meyer Sep. 1973 316 p refs (Contract DAAJ01-72-C-0737; DA Proj. 1728037)

(AD-774305; RR-73-15) Avail: NTIS CSCL 13/8

Areas in which ultrasonic energy can be effectively applied in production metalworking processes, particularly in the manufacture of Army helicopters and light aircraft, were explored. Literature covering ultrasonic applications in various metal forming, metal removal, and metal joining processes was thoroughly reviewed to establish, in each case, the present status and the potential interms of cost effectiveness and product improvement. An annotated bibliography is included in an appendix. Several leading Army aircraft manufacturers were surveyed to examine specific metalworking problems that might be solved by ultrasonic application, and analyses were made to indicate potential benefits and cost savings in these areas. (Modified author abstract) GRA

N74-21105# United Aircraft Corp., East Hartford, Conn. Research Labs.

NONDESTRUCTIVE HOLOGRAPHIC TECHNIQUES FOR STRUCTURES INSPECTION Annual Technical Report, 1 May 1972 - 30 Apr. 1973

R. K. Erf, J. P. Waters, R. N. Gagosz, K. A. Stetson, and G. Whitney Sep. 1973 98 p refs

(Contract F33615-71-C-1874; AF Proj. 73511)

(AD-774758; UARL-M991208-24; AFML-TR-73-193) Avail: NTIS CSCL 14/2

The program is an investigation of the feasibility of using holographic interferometry for the inspection of large aircraft structures in a manufacturing or maintenance environment. The second year's work comprised the following: an investigation of the effects of airborne particulates on the holographic process, a study of holographic methods suitable for the manufacturing or maintenance environment, an investigation and experimental demonstration of two new moire methods for the visualization of strain patterns, investigations of potential stress generating mechanisms, suitable for the holographic detection of cracks, in which it was experimentally demonstrated that surface waves can be generated and attenuated by cracks, and experimental demonstrations that illustrated the potential of holography, in combination with ultrasonic excitation, for solving cooling passage alignment inspection problems. (Modified author abstract) GRA

N74-21139# Ministry of Defence, London (England).

MATERIALS FOR AEROSPACE CURRENT RESEARCH AND DEVELOPMENT

Jun. 1973 18 p

(D-MAT-194; BR38205) Avail: NTIS HC \$4.00

Current trends in materials research and development are outlined with particular regard to airframe materials, engine metals, and nonmetallic materials. Progress in a wide range of metallic and nonmetallic materials required for airframes and aeroengines is briefly reviewed. ESRO

N74-21151# Lockheed Missiles and Space Co., Palo Alto, Calif. Research Lab.

DEVELOPMENT OF ENGINEERING DATA ON THICK-

SECTION ELECTRON BEAM WELDED TITANIUM Final Report, Mar. 1971 - Jun. 1973

John G. Bjeletich Aug. 1973 199 p refs
(Contract F33615-71-C-1338; AF Proj. 7381)
(AD-774051; LMSC-D352462; AFML-TR-73-197) Avail: NTIS CSCL 11/6

The report provides a vital portion of the basic engineering data necessary for the design of reliable and efficient airframe structures involving electron-beam weldments in titanium alloys. Tensile, fracture toughness, and subcritical crack growth properties of both base metal and weldments have been obtained for 1- and 2-in. Ti-6Al-4V and 1-in. Beta III plate. Test temperatures ranged from -65F to 175F and the test environments included laboratory air, water, salt water and JP-4 jet fuel. The concept of stress intensity factors from linear elastic fracture mechanics is used to quantitatively assess the load carrying capacity and crack growth resistance of the test materials. Fracture toughness and tensile properties are tabulated while the fatigue crack propagation and stress corrosion cracking rates are presented in a graphic format. GRA

N74-21187 Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.

DIFFERENTIAL GAME BARRIERS AND THEIR APPLICATION IN AIR-TO-AIR COMBAT Ph.D. Thesis

Urban H. D. Lynch 1973 250 p
Avail: Univ. Microfilms Order No. 74-1108

The mathematical theory of perfect information, zero-sum, differential games is used as an analytical tool to learn about the one-on-one, air-to-air combat problem and the problem parameters which have major effect on its outcome. Emphasis is on differential game Barrier theory and the application of the Barrier as an analytical tool for air-to-air combat analysis. Barrier sensitivity analysis of the models shows that given the opportunity to increase a fighter aircraft's air-to-air combat capability with either improved turning gs, weapons system, or thrust to weight ratio, increased thrust to weight ratio yields the greatest improvement in this capability. Barrier results of the models are designed into a workable computational technique to evaluate the air-to-air combat capability of a series of fighter aircraft. Dissert. Abstr.

N74-21289*# Teledyne Systems Co., Northridge, Calif. INVESTIGATION OF APPLICATION OF TWO-DEGREE-OF-FREEDOM DRY TUNED-GIMBAL GYROSCOPES TO STRAPDOWN NAVIGATION SYSTEMS Final Report

Apr. 1974 381 p refs
(Contract NAS1-12175)
(NASA-CR-132419) Avail: NTIS HC \$22.25 CSCL 17G

The work is described which was accomplished during the investigation of the application of dry-tuned gimbal gyroscopes to strapdown navigation systems. A conventional strapdown configuration, employing analog electronics in conjunction with digital attitude and navigation computation, was examined using various levels of redundancy and both orthogonal and nonorthogonal sensor orientations. It is concluded that the cost and reliability performance constraints which had been established could not be met simultaneously with such a system. This conclusion led to the examination of an alternative system configuration which utilizes an essentially new strapdown system concept. This system employs all-digital signal processing in conjunction with the newly-developed large scale integration (LSI) electronic packaging techniques and a new two-degree-of-freedom dry tuned-gimbal instrument which is capable of providing both angular rate and acceleration information. Such a system is capable of exceeding the established performance goals. Author

N74-21290*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

LANDING RATES FOR MIXED STOL AND CTOL TRAFFIC John S. White Washington Apr. 1974 76 p refs (NASA-TN-D-7666; A-5044) Avail: NTIS HC \$4.00 CSCL 17G

A study was made to determine the expected landing rate

for STOL-only traffic and mixed STOL-CTOL traffic. The conditions used vary from present day standards to an optimistic estimate of possible 1985 conditions. A computer program was used to determine the maximum landing rate for the specified conditions and aircraft mix. The results show that the addition of STOL on a CTOL runway increases the total landing rate if the STOL airborne spacing can be reduced by use of improved navigation equipment. Further, if both takeoff and landings are performed on the same runway, the addition of STOL traffic will allow an increase in the total operation rate, even with existing spacing requirements. Author

N74-21308*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

EFFECTS OF A TRAFFIC NOISE BACKGROUND ON JUDGEMENTS OF AIRCRAFT NOISE

Clemens A. Powell (Southampton Univ.) and C. G. Rice 21 Mar. 1974 15 p refs Presented at 87th Meeting of the Acoustical Soc. of Am., New York, 23-26 Apr. 1974
(NASA-TM-X-71938) Avail: NTIS HC \$4.00 CSCL 20A

A study was conducted in which subjects judged aircraft noises in the presence of road traffic background noise. Two different techniques for presenting the background noises were evaluated. For one technique, the background noise was continuous over the whole of a test session. For the other, the background noise was changed with each aircraft noise. A range of aircraft noise levels and traffic noise levels were presented to simulate typical indoor levels. Author

N74-21396*# Naval Air Propulsion Test Center, Trenton, N.J. Propulsion Technology and Project Engineering Dept.

ROTOR BURST PROTECTION PROGRAM: STATISTICS ON AIRCRAFT GAS TURBINE ENGINE ROTOR FAILURES THAT OCCURRED IN US COMMERCIAL AVIATION DURING 1972

R. A. DeLucia and G. J. Mangano Mar. 1974 20 p
(NASA Order C-41581-B)
(NASA-CR-136900; NAPT-PE-40) Avail: NTIS HC \$4.00 CSCL 21E

Based on FAA data, results are presented that establish (1) the incidence of rotor failure, (2) the type of fragments generated, (3) whether or not these fragments were contained, (4) the causes of failure, (5) where in the engine failure occurred, (6) what engines were affected and (7) what flight conditions prevailed at failure. The rate of uncontained rotor burst was considered to be significantly high. Blade fragments were generated in 95% of the rotor bursts, 20% of which were uncontained. Although fewer disk and rim fragment bursts occurred, none were contained. Author

N74-21568# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.

DETERMINATION OF THE EFFECTS OF MASS AND STIFFNESS ON THE VIBRATION RESPONSE OF RIBBED PANELS SUBJECTED TO RANDOM ACOUSTIC NOISE M.S. Thesis

Clarence M. Bose Dec. 1973 111 p refs
(AD-774436; GA/MC/73A-1) Avail: NTIS CSCL 01/3

The purpose of the report is to experimentally determine the effects of localized mass and stiffness parameters on the vibration response of stiffened panel structures excited by acoustic noise. Eleven panels were constructed, similar in weight and configuration with typical aircraft panel structures. A baseline panel was used to determine reference mass and stiffness properties; five panels were varied in mass with stiffness kept constant, and five panels with constant mass were in stiffness. The panels were excited in an acoustic reverberation test facility using a broad-band siren and horn assembly. Excitation and response measurements were taken using microphones and accelerometer transducers attached to the panels. The data were then reduced and correlated to construct vibration prediction curves as a function of excitation/response levels, frequency, and mass and stiffness parameters. (Modified author abstract) GRA

N74-21569# System Development Corp., Santa Monica, Calif.
CUMULATIVE FATIGUE DAMAGE THEORY AND MODELS
 Final Report. 1 Jul. 1971 - 30 Jun. 1973

V. K. Murthy and G. Boyd Swartz (Monmouth Coll., N. J.)
 Wright-Patterson AFB, Ohio ARL Dec. 1973 78 p
 (Contract F33615-71-C-1776; AF Proj. 7071)
 (AD-774529; ARL-73-0170) Avail. NTIS CSCL 11/6

The report consists of six sections of original contributions to the theory of cumulative fatigue damage of airframe structures and an appendix, which consists of annotated bibliography of some additional important papers in cumulative fatigue damage.

GRA

N74-21591# Imperial Coll. of Science and Technology, London (England). Dept. of Mechanical Engineering.
HEAT AND MASS TRANSFER IN AIRCRAFT PROPULSION

D. B. Spalding Dec. 1973 35 p refs
 (HTS/73/55) Avail. NTIS HC \$4.75

Practical problems of heat and mass transfer arising in aircraft propulsion are reviewed, and classified by reference to the structure of heat and mass transfer theory. It is argued that: (1) the problems are too multifarious to be handled by the traditional method of experiment generalized by way of dimensional analysis; (2) that the methods of classical mathematics, being restricted to linear equations and simple boundary conditions, are rarely applicable; and (3) that numerical methods of solving the governing nonlinear equations with arbitrary boundary conditions, coupled with mathematical models of turbulence, chemical kinetics and other phenomena, are potentially capable of solving the needs of the aircraft engine designer.

Author

N74-21613 Societe Nationale Industrielle Aerospatiale, Paris (France).

TECHNIQUES ORIENTED TOWARDS COST REDUCTION
 M. Chevalier In AGARD AGARD Ann. Meeting, 1973 Dec. 1973 p 22-27 In ENGLISH and FRENCH

It is pointed out that, parallel to the continuous improvement in performance regarding aircraft construction, actions are currently being developed towards simpler materials, open to quantity production, and characterized by a determined tendency towards economy. Three aspects are dealt with concerning the vehicle production: (1) structure, (2) power plants, and (3) equipment.

Author

N74-21614 National Aerospace Lab., Amsterdam (Netherlands).
TECHNICAL AND OPERATIONAL ASPECTS OF EXTERNALLY-MOUNTED AIRCRAFT EQUIPMENT

T. VanOosterom In AGARD AGARD Ann. Meeting, 1973 Dec. 1973 p 29-34

It is pointed out that the installation of additional equipment in an aircraft is often impossible due to space limitations. Consideration is given the choice which must be made between redesigning or modifying the fuselage, or housing the equipment in an external speedpack or pod. Several advantages of a pod-mounted system are indicated and specific design aspects which may require advanced applications of science and technology are discussed. It is concluded that the pod concept has the potential to solve, in many cases, the problems inherent in the implementation of new operational equipment within the inventory of an air force. It is also concluded that for many applications the pod concept will have a superior operational cost effectiveness in comparison with an aircraft-integrated system.

Author

N74-21615 Ministry of Defence, London (England).
THE REDUCTION OF AIRFRAME COSTS WITH PARTICULAR REFERENCE TO COMBAT AIRCRAFT

J. Seddon In AGARD AGARD Ann. Meeting, 1973 Dec. 1973 p 34-39

It is stated that for modern aircraft weapon systems such as a multi-role combat aircraft, cost reduction can be achieved

at all stages of the procurement process, and by a wide variety of means. Some examples are presented of recent achievements in the following three phases: aerodynamic and structural design, mechanical and physical engineering, and manufacturing technology.

Author

N74-21616 Ministry of Defence (West Germany).
THE HINGELESS ROTOR: A CONCEPT TO INCREASE MISSION EFFECTIVENESS AT REDUCED COSTS c02

R. Barth In AGARD AGARD Ann. Meeting, 1973 Dec. 1973 p 40-50 refs

The mechanical simplification of helicopters by elimination of blade attachment hinges is discussed. Emphasis is placed on the Bolkow system which features fiberglass rotor blades of high elasticity rigidly attached to a stiff hub. The stated advantages of the system are: (1) The hingeless rotor design needs only about 30 percent of the parts of an articulated rotor. (2) Control becomes more powerful, faster and more direct, and nearly independent of thrust. (3) The rotor blades can offer more than 10,000 hours of service life compared to 1,000 to 2,000 hours for comparable helicopters. (4) The fiberglass material is corrosion proof and tests have shown that it is insensitive to notches. (5) The hingeless rotor is most promising in fulfilling modern military requirements for air mobility.

D.L.G.

N74-21617 Avions Marcel Dassault-Breguet Aviation, Saint-Cloud (France).

RESEARCH WORK AND COSTS, THE ROLE OF DATA PROCESSING

P. Bohn In AGARD AGARD Ann. Meeting, 1973 Dec. 1973 p 51-53 In ENGLISH and FRENCH

An overview is presented on research work and costs in aircraft manufacturing with emphasis placed on the changes which have taken place as a result of the introduction of powerful computers. It is pointed out that computers provide a means to improve the modelling of physical phenomena and to demonstrate the resulting effects on the whole aircraft. Aircraft manufacturers are now in a position to achieve trade-offs which were at one time inconceivable, especially as far as costs are concerned. It is predicted that in the future, research work will require more highly trained engineers, extremely powerful computers, and very bulky data files. These requirements are based on: (1) In-flight development time is becoming increasingly short, and is devoted more and more either to the development of electronic systems, or to the analysis of abnormal flight patterns or failure investigations. (2) Official agencies and industrial firms everywhere must more and more frequently accept contracts for the development of prototypes. (3) Optimization, Obtained by computers, permits the manufacturer to simplify without incurring any penalties as regards the objectives.

D.L.G.

N74-21618 Air Force Systems Command, Wright-Patterson AFB, Ohio.

IMPACT OF TECHNOLOGY ON COST REDUCTION

John F. Brooke In AGARD AGARD Ann. Meeting, 1973 Dec. 1973 p 53-60

The results are discussed of a United States Air Force survey conducted to identify those technologies which hold the greatest promise of reducing life-cycle costs. The analysis indicates that the cost reducing aspects of seventeen identified technologies could achieve a ten year life-cycle savings on the order of \$450 million. Five of these technologies, considered to be representative examples, are discussed in detail and include: (1) advanced composites, (2) weldbond joining, (3) metal working and munitions, (4) replaceable tread tire concept, and (5) aircraft battery technology.

D.L.G.

N74-21629# Battelle Columbus Labs., Long Beach, Calif. Research Facility.

SHIP-HELICOPTER SYSTEM ANALYSIS Final Report.
 16 May - 30 Nov. 1973

N74-21629

R. A. Egen, J. C. Minor, and H. A. Cress 7 Dec. 1973 41 p
refs

(Contract DOT-CG-23223-A)

(AD-774764; USCG-D-44-74) Avail: NTIS CSCL 13/10

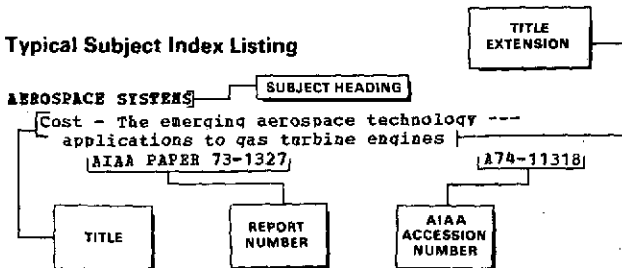
The objective of the report is to identify limitations to Coast Guard ship-helicopter (ship/helo) operations on WMEC and WHEC class vessels, and to study possible ways to remove these limitations to increase ship/helo utilization. A systems analysis technique was used to identify and describe the interrelationships among the system elements which affect ship/helo operations. Inherent limitations of ships and helicopters are described, as well as possible missions and modes of combined operations. Special consideration is given to the HARPOON, BEARTRAP, and SHAG helicopter rapid-securing and release systems.
(Modified author abstract) GRA

SUBJECT INDEX

AERONAUTICAL ENGINEERING / A Special Bibliography (Suppl. 46)

JULY 1974

Typical Subject Index Listing



The title is used to provide a description of the subject matter. When the title is insufficiently descriptive of the document content, a title extension is added, separated from the title by three hyphens. The NASA or AIAA accession number is included in each entry to assist the user in locating the abstract in the abstract section of this supplement. If applicable, a report number is also included as an aid in identifying the document.

A

AC GENERATORS

Major Item Special Study (MISS), CR-47A
alternating generator --- product quality
control and cost savings
[AD-773720] N74-19712

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Aircraft on-board equipment for dynamic
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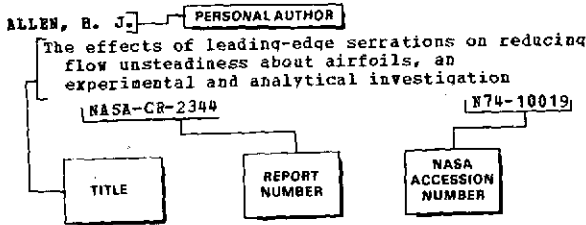
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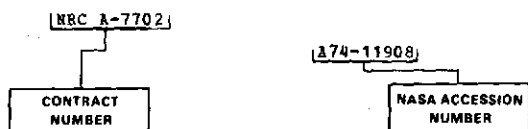
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